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JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania

AND

MECHANICS' REGISTER.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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THIRD SERIES.

VOL. I.

PHILADELPHIA.

PUBLISHED BY THE FRANKLIN INSTITUTE, AT THEIR HALL.

1841

JOURNAL
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JANUARY, 1841.

Address to the Subscribers to the Journal of the Franklin Institute, and to the Public generally.

The Committee on Publications of the Franklin Institute, have determined to commence a New Series of the Journal under their charge, with the beginning of the new year. The January number will, accordingly, be No. I of the Third Series of the Journal of the Franklin Institute.

This change they intend to connect with renewed efforts, as well in the intellectual matter as in the mechanical execution of the Journal.

The valuable papers of the late Chevalier de Gerstner and Mr. Klein, relating to the internal improvements of the United States, will be continued, and the Committee renew their solicitations to American Engineers to contribute the results of their practice to the valuable materials thus furnished to the American public by these distinguished foreigners. One of the most useful British journals contains numerous articles from the daily practice of engineers, which, though short, are interesting as well as valuable, results similar to which must be collected in every summer's work in the field. The Committee are indebted to Thomas U. Walter, Professor of Architecture in the Institute, for the promise of original and selected matter in his interesting department.

The deductions of the Committee on Water Power, from the elaborate series of experiments made by them, and already published in the Journal, will be furnished in this new series, the first part being prepared for the February number. The valuable abstract of patents, with remarks upon them by the Editor, Doctor Thomas P. Jones, will

be continued, as well as the publication of such specifications as appear to merit being given without abridgment. The Committee will endeavour, at the earliest possible date, to procure such notices of the various manufacturing establishments, machine shops, &c. of Philadelphia, as may serve to give an idea of the state of industry in the city, without bringing individual interests into conflict, and would invite the contribution of similar notices from other parts of the Union. They again urge mechanics to contribute practical matters to the journal, and thus to render their knowledge conducive to the general progress of the arts in which they are interested. Besides the view given of the progress of mechanical science by original articles and selections from journals at home and abroad, the Committee are promised notices and abstracts, exhibiting this progress in a more condensed form, by John C. Cresson, Professor of Mechanics of the Institute.

Original articles in chemical and physical science, will, as heretofore, be sought for. As an instructive mode of presenting the condition of particular branches, original essays upon them will be published, and their progress will be recorded by abstracts of the more important investigations in them. The department of general and practical chemistry will be under the charge of Dr. John Griscom, James C. Booth, Professor of chemistry applied to the arts, in the Institute, and John F. Frazer, Professor of general chemistry in the Institute. Translations of interesting articles from the French and German, will be made by Dr. Griscom and Professor Booth. The notices of physical science including astronomy, will be furnished by Professor A. D. Bache, and Sears C. Walker, Esq. The Committee have already incurred a debt to the last named gentleman of obligation for furnishing, in conjunction with Professor Kendall of the Philadelphia High School, the calculations of occultations for several years past. These will still be furnished by the care of these gentlemen from their own calculations or those of Mr. Downes, of Worcester, Mass., whom the Committee are gratified to add to the number of their correspondents.

To improve the mechanical execution of the journal, an entire new fount of type has been provided, by arrangement with the enterprising printer, Mr. Jesper Harding.

These improved arrangements entitle the Committee to ask, from the public generally, and especially from mechanics, an extension of the patronage heretofore given to the journal. The addition of one hundred subscribers to the present list would enable them to support entirely the expenses of the journal, which have heretofore been borne by the Franklin Institute at a small annual loss. Two hundred addi-

tional subscribers would enable them to reduce the price of the journal, which they pledge themselves to do in the event of such an increase to the present list. The object of the Franklin Institute in establishing the journal, was to diffuse knowledge, and not to reap pecuniary profit, and in that spirit the past and present arrangements have been made.

A liberal compensation will be paid, as heretofore, for articles accepted for publication in the journal.

The journal will, in future, be published on the first of every month, the delay in the first number of the new series is unavoidably connected with the arrangements already referred to.

John C. Cresson,
Isaac Hays,
Samuel V. Merrick,
Alex. Dallas Bache,
Matthias W. Baldwin,
Isaac P. Morris,
} Committee on Publication.

Hall of the Franklin Institute of the state of Pennsylvania, for the promotion of the Mechanic Arts.

December, 1840.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

(Continued from Vol. XXVI., page 363.)

Letter VII.

Louisville, Kentucky, June 5, 1839.

The Banking System in the United States.

The Banks have acquired such an extension and importance in the United States, and they are so intimately connected with every thing here, that no day passes without their being an object of conversation in almost every circle, and without observations being made about them in the public press, or Reports of Banks appearing in the papers. One would imagine, that the United States could not exist without banks or without credit, and if you ask, how so many populous, well-built towns have been erected in such a short period; how the im-

penetrable forests in the West have been cleared and cultivated; how the swampy lands on the Mississippi have been transformed into the finest sugar and cotton plantations; how, finally, this general prosperity, which is everywhere visible, has been produced in such a few years; the answer is, "we derive all this from our banking, our credit system; because credit is the first element of the welfare of the Union!"

I once visited a car builder in Philadelphia, who is pretty well known for his ability, but until now did not acquire any property, on account of his expending too much in constantly making experiments for improvements in the construction of rail road cars.

"Are you able to take a large order for rail road cars?" I asked the man. "Yes," replied he," "I can take an order to the amount of $20,000 and more, and require the payment to be made only at the delivery of the cars, in bills at six months." "But how are you able to accomplish this, without being in possession of capital?" "Nothing easier than that. After having made my contract with you, I go to a large timber yard and select what I want in lumber and boards; the timber merchant, on seeing my contract, gives me credit for at least eight months, during which time I fulfil my order. In the same manner, I get the iron, leather, brass, and whatever I want, also on a credit of eight months. I further want cash, to pay my workmen every week, to obtain which, I sell my note, which I get endorsed by one or two friends, to some bank; in this manner I go on with my work, and when I am paid at the delivery of the cars, in bills at six months, I settle my accounts with the lumber merchant and the other individuals, and pay them with the bills I have received. The lumber merchant himself, continued the car builder, has not paid for the whole of his stock; he obtained the timber from the proprietors of forests in the interior, who obtained advances from the banks, when they commenced cutting the timber; it is the same with the iron merchant and all others, who give me credit; they sell me articles which they have not yet paid for themselves, and the first producers have already obtained on their account considerable advances from the banks. This is the course every business takes here; we undertake every thing on credit; whoever has learned a business, and is active and honest, finds credit and money to accomplish every reasonable enterprise. It sometimes happens, that the speculation fails, and the speculator in consequence; he then settles with his creditors, pays them what is left, and commences anew. There are men who have failed four or five times in their lifetime, always recommenced, and again found credit, because they were known to be active and honest; some of them acquire at the end of their life, a considerable property, while others remain poor. The banks and other creditors

easily sustain single losses of this kind, because the mass of their business is so great, that in the whole, they always realize great profits. Thus we proceed in the new world; in the old world, they say, every hing is established upon a solid, durable foundation, and therefore an able and active young man finds no support, if he is deprived of capital; therefore so few undertakings are brought to maturity, as only such, which promise a secure and certain success, are taken up; but experience has shown there, that with all these precautions, they are sometimes found to have made a wrong calculation, and as at the same time the mass of business is proportionally so much smaller, the profits of individuals must be considerably less in the old world, than with us, and the general prosperity of the country must be far less on the increase than in the new world, under an active, industrious, and unprejudiced population, giving each other a mutual support." Such were the words of the car builder; six months have since elapsed; I have almost daily recalled to myself his words, and daily I found new proof of their truth. But the American credit system is such an enormous structure, it is so differently practiced in the twenty-six sovereign States of the Union, and like every other good thing, so much misuse has been made of it, that much time, conversation with well instructed individuals, and mature reflection are required, justly to comprehend the system in its principles, and to judge, how far the same would be practicable for our European institutions. It is the same with this as with the rail road system, the Americans have, in the course of ten years, completed 3000 miles of rail roads, and are always making new alterations and improvements; they have, in the last twenty-five years, established over 700 banks, and in almost every one of them have made some new experiments and amendments. There is no plan of construction of rail roads, there is no system of banking, that has not been tried here, and as the reports of most of the banks as well as of the rail roads, are published annually, we may find here, in regard to banking, instruction not to be obtained in any other part of the globe.

I have had occasion to speak in my last two letters of some banking institutions in the States of Georgia and Louisiana; this letter will contain a short history and description of the American banking system in general, and in my future letters I shall give a more detailed account of the establishment and management of Banks in the different States of the Union.

National Bank, or Bank of the United States.

The Americans had already, while they were English colonists, several banks; but after having made themselves independent of the

English sovereignty, they became more enterprising, wanted more credit, and therefore increased the number of their banks. Every State of the Union granted, at its discretion, bank charters, by which incorporated companies became authorised to issue notes and transact all business connected with banking, within the precincts of the respective States. They soon felt, however, that to obtain an uniform circulating medium, a common central institution was required, and they established in the year 1791, a national bank, called "The Bank of the United States," for which the charter was granted by Congress, and which was therefore recognised throughout the whole Union. The capital of this bank was $10,000,000, of which the general government paid in one-fifth; the term of the charter was twenty years. As most of the banks in the different States (State banks,) had only a capital of some few hundred thousand dollars, the bank of the United States not only did the largest business, but soon acquired a control over all State banks; as soon, namely, as any of these banks brought into circulation too great an amount of notes, or entered into unsafe speculation, the national bank refused its credit, and either did not accept the notes of that institution or sent them to be redeemed in specie. The national bank thereby obtained a powerful influence upon the money matters of the Union, a general complaint about its monopoly arose, and after the expiration of the term of its charter in the year 1811, the latter was not renewed.

In the year 1812 the war commenced between the United States and England; as a natural consequence, credit and enterprise declined, the public rushed to the banks to convert their notes into specie, and the banks were compelled to suspend specie payments. When peace was re-established, in the year 1815, the Union contained over 200 banks, whose notes were, according to the credit of the different institutions, taken at a discount of from 20 to 50 per cent., a great number of private individuals, at the same time, had emitted small notes or obligations, which circulated in the neighbourhood; the whole country was inundated with paper money—gold and silver had entirely disappeared. A plan for a national bank was presented to Congress by Alexander James Dallas, then Secretary of the Treasury, and after a long deliberation in that body, a law was passed in the year 1816, incorporating the second bank of the United States with a charter for twenty years; the capital of this bank was $35,000,000, paid in 350,000 shares, at $100 each, to which the general government again contributed the fifth part. The bank was administered by twenty-five Directors, five of whom were appointed by the federal government; the Directors elected from amongst themselves a President, the latter had a salary, but not the Directors. The principal bank was in Phi-

ladelphia, and twenty-five branch banks were located in the most important commercial places of the Union. The bank had great confidence and credit with the first merchants and bankers in England and France, and was conducted with an ability, which was acknowledged by every one, whether a friend or enemy to the institution.

The federal government employed this bank to receive from the collectors the revenues from duties and from lands sold at the different points of the country; to keep the sums in custody until wanted, and to pay the money out again, wherever it was required; the bank paid all pensions arising from the Revolutionary and late wars, the capital and interest of the national debt; and after the latter was extinguished, had always several millions of dollars of the surplus revenue on deposit. The bank paid no interest to the federal government on the sums confided to her, but at the same time made all the payments required at the different points of the Union, without charging anything for commission. The general government lost in this way the interest on its uninvested revenue, but spared a whole army of treasury officers, saved the cost of transportation, which was considerable twenty years ago, from the want of internal improvements, and finally, as long as it availed itself of the national bank, the general government had not to complain of a single loss, however small.

The confidence of private individuals in this institution was not less; whoever had uninvested capital, deposited the same in the mother bank or one of its twenty-five branches, an account was opened for him, and the bank paid his checks at sight. This was found so convenient, that by and by all capitalists gave to the national bank or one of its branches, or else to another bank, their bills for disbursement, and had all their payments made through the same. The bank did not take any commission for these transactions, but paid no interest on the money deposited. In this manner individuals dispensed with the trouble of exchanging money, which is no easy matter with the mass of different bank notes existing, many of which are often below par; they were relieved of the trouble of making their payments themselves, and finally were not in danger of losing money by thefts or otherwise. Merchants and others find it convenient to continue this course now, and you seldom find, in a counting house or private lodging, \$50 in cash, as all the money goes through the hands of the banks.

According to its charter the National Bank could lend to the Federal Government at the most \$500,000, and to the governments of the different states only \$50,000. The bank issued notes which were received throughout the whole Union by individuals and public officers at par with specie, but were also immediately redeemed in gold or sil-

ver on presentation. The notes of the smallest denomination were of five dollars. The bank discounted bills with two endorsements, payable not later than four months, made advances upon state bonds and other public papers, and purchased and sold gold and silver; according to the charter the bank could not buy and sell public funds, and might possess only such real estate as was mortgaged to them and forfeited in consequence of non-payment. The rate of discount was fixed at 6 per cent. per annum, and as the bank constantly had a large amount of money in its vaults, the dividends on the bank shares usually were only 7 per cent.

The National Bank, which, as above stated, was founded for the second time in the year 1816, commenced business on the 1st of January, 1817, and as early as the 20th of February of the same year, the state banks in the large cities resumed specie payment. Those banks, which could not resume, lost all their credit and had to wind up their affairs. In the year 1819 perfect order was again re-established, and the National Bank had the control over all the state banks. For the second time the cry of monopoly was raised, and when the President of the United States, General Jackson, began to look upon the National Bank as a foreign power in the state, which he could not reconcile with his democratic views, he not only withdrew from the bank, in the year 1834, the moneys deposited by the Federal Government, but also vetoed the bill passed by Congress for the renewal of the bank charter. The bank after having paid over the deposits of the Federal Government, curtailed the discounts, diminished its business operations, and the country was seen to approach a new commercial crisis. After the expiration of the charter of the United States Bank, on the 3d of March, 1836, the banks in the different states recommenced expanding to excess, and a general crisis followed, from which the country is still not quite recovered.

The stockholders of the late National Bank were offered a charter by the State of Pennsylvania, and accepted from that state on the 18th of February, 1836, an act conferring banking privileges for thirty years, under the following provisions: the State of Pennsylvania was to receive as bonus $2,500,000 immediately, and besides, during twenty years, annually $100,000; the bank was to subscribe $675,000 for canals, railroads, and turnpikes; and is finally bound to lend to the state $6,000,000 upon state bonds, bearing 4 per cent. interest, to be taken at par, or upon bonds, bearing 5 per cent. interest, to be taken at 10 per cent. premium. Notwithstanding these heavy conditions, the bank, with a capital of $35,000,000, is very prosperous; and although its notes have legal value only in Pennsylvania, they are accepted in all the other states and often with a premium of one or more per cent.

Banks of the different States.

Bank charters are granted in most of the states of the Union with great liberality; in some of them without further indemnifications, in others for a certain bonus or part of the profit, and generally for a term of from twenty to twenty-five years. The issue of bank notes, and their proportion to the specie is generally left to the discretion of the banks. Most of the banks have a great number of shareholders; there are, however, a few cases, where banks were established by a few individuals. Generally, the legislatures preserve to themselves the right to enquire into the condition of the banks from time to time by commissioners appointed for this purpose; and the banks have to make reports periodically. The President, Cashier, and inferior officers have always salaries, the directors none: a general meeting of the stockholders is held annually, when a report is read to them, and they are made acquainted with the amount of dividends declared by the directors; at this meeting the stockholders elect a new board of directors, and in this manner may exclude from the administration single members or the whole board if they think proper. Such of the banks as appear the most secure are chosen by the Federal Government or the State Governments to receive their deposits and make the payments, as was formerly done by the National Bank.

With this diversity in the banking system, the most diverse results must be presented to us, and as the president and directors of the banks always seek to make the largest possible dividends, it is evident that they embark in a number of speculations, which ought not to be undertaken after mature reflection. Some of the banks possess specie to the amount of 50 per cent. of their issued notes, and therefore readily redeem all the notes presented to them, in gold or silver; other banks have issued three and even twenty times as many notes as the amount of specie in their vaults; whenever a new business offered itself new notes were issued, and when the time of payment came, individuals made new debts; such has been the state of affairs since March, 1836, when the National Bank was discontinued. It became with the banks the same as with the members of a new free colony, where every body is left to himself and may act at his own impulses; disorder and finally anarchy must be the natural consequences. On the 3d of March, 1836, the National Bank, until that time the head of the monied institutions of the Union, was discontinued, and already on the 10th of May, 1837, all the banks in the city of New York by mutual agreement stopped payments in gold and silver; a few weeks after, the other banks in the Union had to follow the same course, and it was not until the latter part of 1838 that specie payment was again resumed. The contest, about the establishment of a National Bank

for the third time, still continues, and has occupied Congress in its last session. The Democratic party, as it is styled here, appeals to the farmers and mechanics, as the most numerous part of the population of the United States, and reminds them of the losses they sustained by the frequent bank failures and suspensions of specie payments, while the opposite, or Whig party, repeats to the same farmers and mechanics, that the banks advanced the money for the purchase and improvements of the lands, which otherwise would have remained profitless; that the enterprising working man obtains money from the banks or credit from the merchant; that finally, the mason, the carpenter and every other mechanic owe it to the credit system, that their wages rose to two and three dollars per day; that, therefore, the banks, numerous and extensive, are indispensable to the welfare of the Union, and a National Bank of the highest importance to the same. The coming Presidential election will decide which of the two parties will obtain the victory.

Number and operations of the Banks in the United States.

To give a clearer view of the extent and operations of the banks in this country, I communicate an extract from two reports, made to Congress by the Secretary of the Treasury, one on the 8th of January, and the other on the 7th of June, 1838.

Date.	No. of banks without branches.	Banking capital.	Amount of deposits.	Notes in circulation.	Amount of loans and discounts.	Specie on hand.
		Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
1st. Jan., 1811	89	52,601,601		28,100,000		15,400,000
Do. 1815	208	82,259,590		45,500,000		17,000,000
Do. 1816	246	89,822,422		68,000,000		19,000,000
Do. 1820	308	137,110,611	35,950,470	44,863,344		19,820,240
Do. 1830	330	145,192,268	55,559,928	61,323,898	200,451,214	22,114,917
Do. 1834	506	200,005,944	75,666,986	94,839,570	324,119,499	
Do. 1835	558	231,250,337	83,081,365	103,692,495	365,163,834	43,937,625
Do. 1836	567	251,875,292	115,104,440	140,301,038	457,506,080	40,019,594
Do. 1837	634	290,772,091	127,397,185	149,185,890	525,115,702	37,915,340
Do. 1838	675	317,636,778	84,691,184	116,138,910	485,631,867	35,184,112

Since the 1st of January, 1838, the number of banks has again increased, and their capital may now amount to not less than three hundred and fifty millions of dollars.

What an immense difference between this enormous capital and the insignificent one, which the few banks upon the continent of Europe, and especially in Germany, are in possession of. The Austrian Empire has now 34,000,000 of industrious inhabitants, and shall a single bank suffice for this immense country from the frontier of Russia down

to Dalmatia? Shall a single bank animate its commerce, make its industry and manufactures prosper, and elevate its agriculture? How much good could be effected, how much could the prosperity of the empire be increased, if at present, when the charter of the bank* expires, a separate bank were established at least in each of the provinces comprising that large Empire, headed by a great National, or Central Bank, and if their statutes were founded upon the extensive experience hitherto made in banking in Europe and in America.

To be continued.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Architecture.

A taste for architecture is not only an evidence of refinement and mental cultivation, but it affords a prolific source of enjoyment; a knowledge of the arts is one of the most desirable accomplishments of life.

Architectural objects are constantly before us whichever way we turn, and new buildings are continually springing into existence in every part of the country. Hence, if a taste for this useful, as well as polite, art, was generally cultivated, its beneficial influences would be co-extensive with the objects it creates, and all the buildings required for the comforts and conveniences of life would consitute so many sources of enjoyment; while at the same time they would embellish the country, elevate the standard of civilization, and throw an imperishable lustre around the national character.

In view, therefore, of the good to be derived from a diffusion of knowledge in architecture, some allusion will be made to this important subject in each succeeding number of the Journal, and such articles will be selected from time to time from the pages of other publications as may tend to promote so desirable an object.

Porticoes.—The similarity which exists in modern adaptations of columnar architecture is as adverse to the spirit of classic art as it is tiresome and monotonous in its effect. A portico is now considered almost indispensable to a design, and the orthodoxy of architects in matters of taste seems to be estimated wholly by the accuracy with which *orders*, and even whole *temples* are copied from the antique.

We often find laboured imitations of the Parthenon, the Theseum, the Erechtheum, and other relics of Grecian genius, executed in situations which not only degrade the beautiful originals, but betray a deplorable want of taste even in adaptation; and yet these "classic models," no matter how absurd their application may be, are tolerated and even justified, on the ground of "*authority.*"

* The National Bank at Vienna.

The popular idea that to design a building in Grecian taste is nothing more than to copy a Grecian building, is altogether erroneous;—even the Greeks themselves never made two buildings alike, nor had they any fixed rules for proportioning the details of either of their orders,—they observed a uniformity of principle,—a correspondence of expression; but always without imposing any fetters on genius other than the limits that nature herself has drawn.

A portico may therefore be designed in Greek taste without being exactly like any thing that ever existed in Greece; it may possess the spirit and beauty of Grecian compositions and yet be different in its disposition, as well as in its details.

If architects would oftener aim to *think* as the Greeks thought, than to *do* as the Greeks did, our columnar architecture would possess a higher degree of originality, and its character and expression would gradually become conformed to the local circumstances of the country, and the republican spirit of its institutions. T. U. W.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Unalterable Blanks.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination Unalterable Blanks, made by Benners & Dainty, of Philadelphia, Penn.: Report,

That, the basis of the ink employed is of such a nature that the ordinary bleaching agents, employed to remove writing made on them with ordinary ink, will at the same time remove the basis on which the writing occurs, thereby rendering it difficult or almost impossible to remove or alter the amounts specified without so altering the basis as to destroy or change it in such a manner that the fraud may be detected.

The principle of the method is not novel, but it appears that the basis of the ink they employ is more easily effaced than that of ordinary checks. It should be observed that the above remarks refer to writing made with ordinary ink, and that the blue ink may be effaced without materially affecting the basis written on.

By order of the Committee.

William Hamilton, Actuary.

Philadelphia, Dec. 10, 1840.

Report on an "Improvement in the Apparatus for generating Steam."

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an "Improvement in the apparatus for generating Steam," by Phineas Bennet, of New York, present the following Report in part—

The first essential part of Mr. Bennet's plan is the employment of a close or air-tight furnace, within which the combustion of the fuel is effected. For this purpose, the air which feeds the fire is introduced into it through tubes, under a great degree of pressure, by means of blowing-cylinders or other competent apparatus, worked by the power of the engine; a part of the air entering below the grate-bars so as to pass through the fuel, and a part entering near the upper surface of the fire so as to cause the entire combustion of the smoke. The ash-pit is made close, but may be temporarily opened, by a valve or cock, to remove the ashes. The fuel (which is oak or hickory wood) is introduced through a vertical iron cylinder over the furnace, which has two steam-tight partitions sliding across it, so as to include a chamber between them. When the upper slide alone is opened, the fuel can be introduced into the chamber; and, when this is closed and the lower slide opened, the fuel falls into the fire, which is thus fed, without an opening into the external air.

The close cylinder in which the fire is thus maintained is surrounded by the boiler, whether it be vertical or horizontal, and is always enveloped by water. The gaseous products of the combustion pass from the fire-chamber through a cylindrical collar, or pipe, at the top, which rises through the water into the steam. Over this collar is suspended an inverted cylindrical box, the edges of which enter to a small depth into the water—the whole arrangement constituting what is called a cap-valve. In this way, the heated gases from the fire pass partially through the water, and assist in the generation of the steam.

The steam and gases now pass together into the cylinder of the engine, and operate conjointly upon the piston by their elastic power.

In this brief description many details are necessarily omitted—such as the arrangement for kindling the fire, &c., but it includes all that may be considered characteristic of the apparatus.

Three questions now present themselves for the consideration of the committee. The first has regard to the originality of the plan, the second to its efficiency, the third to the true principles on which it operates.

As to the originality of the plan, the committee are constrained to say, that the claims are very slender.

In a work entitled "The Abortion of the Young Engineer's Guide," published in Philadelphia in 1805, our ingenious and celebrated countryman, *Oliver Evans*, describes, under the name of "The Volcanic Steam Engine," what must be considered as the first conception of all the instruments of this class. The book is now so rare, and the description so full of interest, that the committee deem it proper to copy the whole article on the subject, which is as follows:—"In our pursuit of means to prevent the loss of the heat which is carried up the chimney of the furnace, let us have recourse to the works of nature. View the natural volcanoes, where the fire burns without the aid of atmospheric air; where all the elastic fluid generated by the fire dissolving the fuel, and all the steam formed by the water that may occasionally come in contact with the fire, united, form the most terrible and powerful of all steam engines; in which the furnace, boiler, and working cylinder are united in one, working on the simple principle of applying great elastic power; casting up mountains, and making the earth quake, as she brings her strokes. To apply these principles as far as we can, we make a cylindric boiler, about thirty-six inches diameter, eight or ten feet high, with a furnace inside of it eighteen or nineteen inches diameter. Both the boiler and furnace are united to the same heads, the fire being inside of the water, and the smoke flue turned downwards through the water to the bottom, where the smoke is vented and rises in many streams of small bubbles, that it may impart all its heat to the water to generate steam. The elastic fluid generated by the combustion of the fuel, which we may suppose is two thousand times the bulk of the fuel, and the air used to kindle the fire, expanded by the heat to double its original bulk, unite with the increased quantity of steam to work the engine with great elastic power. But until we can discover a fuel that will burn without the aid of atmospheric air, or until we can find means for kindling the fire with a blast of highly rarified steam, as may be the case in volcanoes, we use a forcing air-pump to force in air to kindle the fire. This form of engine will work with much less fuel, and be much lighter, than any other. It would therefore be more suitable for boats or land carriages, &c. I made a small boiler on this principle, which operated favourably; but being weary of the trouble and expense of putting new principles into practice, I declined the pursuit, until better prospects open, or a more favourable opportunity offers."

In 1824, and subsequently in 1828, *Mr. Samuel Hall* took out a patent in England, for a scheme, (figured and described in volume xii. of the London Mechanics' Magazine,) which agrees with Mr. Bennet's, in using a close furnace, in urging the fire by an artificial blast, in surrounding the fire-chamber by the boiler, and in conveying

the steam and the gaseous products of the combustion, together, into the cylinder of the engine. This inventor, however, did not pass the gas through the water, and, for some motive, caused part of the steam to pass through the fire. He also made use of two furnaces and two boilers, in order that "while one was being replenished with fuel, the other might, at the same time, be employed in the generation of vapour."

In the Mechanics' Magazine, for December 1829, *Mr. William Gilman* gives a description of an apparatus, illustrated by figures, which may be considered a modification of Hall's, but which much more closely resembles that of Mr. Bennet. A single close furnace is used, surrounded by the boiler; the fire is urged by a blast introduced both below and above the fuel; a regular supply of fuel is dropped in from the top; the gases from the combustion are made to pass through the water so as to aid in generating the steam; and lastly, the steam and hot gases pass together into the cylinder of the engine. The identity of this apparatus with that of Mr. Bennet is therefore perfect as to principle; nor is there any material difference in the mechanical arrangements. Mr. Gilman does not, indeed, describe his method of supplying the fire with fuel, and the contrivance used by Mr. Bennet forms one of the claims in his patent. But *Lord Cochran and Mr. Galloway* took out a patent, in 1818, for a steam engine, in which an air-tight furnace urged by a blast was used, and where the method of supplying fuel to the fire was the same as that adopted by Mr. Bennet, except as to the kind of movable partitions employed—a point admitting of great variety. The only real peculiarity in Mr. Bennet's arrangement seems to consist in the cap-valve, to which he lays special claim. It cannot be supposed, however, that an ingenious mechanic would meet with much difficulty in substituting for it some other valve equally advantageous.

While the committee thus fulfil their duty in presenting the whole truth as to the defect of originality in Mr. Bennet's plan, it gives them pleasure to state that he appears to have a just claim to the merit of being the first to carry this plan into successful operation. If Hall's engine was ever tried, its being abandoned shows that it must have failed. The correspondence in the Mechanics' Magazine, on the subject of Gilman's plan, renders it highly probable that his engine was never constructed at all, notwithstanding his assertions to the contrary. If then this novel arrangement possesses the advantages which are claimed for it, the community is indebted for them to the enterprise, perseverance, and skill of Mr. Bennet.

An opportunity of seeing the new engine in operation has not yet been given to the committee, but is promised by the gentleman interest-

ed in the project. When this personal examination shall be made, the committee will complete their report, so as to include the remaining points presented for their inquiry. The evidences given as to the saving of fuel in Mr. Bennet's engine are of the most extraordinary character, and make it a matter of public interest that the facts should be exhibited to an impartial tribunal.

By order of the Board.

WILLIAM HAMILTON, Actuary.

Philadelphia, Oct. 1st, 1840.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1839.

With Remarks and Exemplifications by the Editor.

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1. For a Wooden or Frame Bridge, denominated *The Suspension Bridge;* Stephen H. Long, Col. U. S. E., November 7.
(See specification, vol. xxiv. p. 325, 2nd series.)

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2. For a Wooden or Frame Bridge, denominated *The Brace Bridge;* Stephen H. Long, Col. U. S. E., November 7.
(See specification, vol. xxiv. p. 328, 2nd series.)

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3. For improvements in *Coaches, and other Carriages;* Thomas Shriver, Cumberland, Allegheny county, Maryland, November 7.

There is too much complexity in the apparatus described in the specification of this patent, to admit of verbal description, the drawings contain twenty-two separate figures, and some of them with numerous references. The following are the claims.

"*First.* The extension of the perches beyond the jack bars and axles. The mode of staying the jacks outside, in vehicles of every description on rail roads, or common roads, in the manner herein described, or in any other substantially the same. The mode of supporting the tongue by a slider, or sway bar, in front of the axle tree. The plan of bending the side perches inwards, better adapted for light vehicles on roads, &c.; and the mode of stocking the axle trees, and arching them upwards, as described. I also claim the brake acting against the road; or if a rail road against the horse path, or rails, by means of the above, or any other mode substantially the same, and the window-bearing, turning on its centre, whether circular, or other shape, operating as herein described, or in any other manner substantially the same."

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4. For *Blue Writing Fluid;* Henry King, city of Baltimore, Maryland, November 9.
(See specification.)

5. For *Coupling Two or More Ploughs;* to be worked by one team; Joseph Card, Painsville, and Grandison Newell, Mentor, Geauga county, Ohio, November 9.

"The nature of our invention consists in attaching to the draught end of the plough beam, a coupling case of such length as is desired, according to the number of ploughs to be worked at once, and so constructed as that each plough shall run truly, steadily, and at any given distance from its fellow."

The claim is to "the mode of drawing one, and of coupling two or more ploughs together, by means of the case, stirrups, and bolts, as described."

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6. For a *Bee House, or Hive;* John Schole, city of New York, November 9.

This Hive, or House, is very ingeniously contrived, so as to present the advantages sought for in a simple and economical manner. The outer case, or body of the hive, is an ordinary flour barrel, and within this there are placed a number of boxes, made of very thin pine boards, joined together in the rough, and in such form as to fill up the capacity of the barrel, and to be readily removed when full, and their places supplied by others. We shall not attempt a description of the manner of establishing the requisite communication between the respective parts, with the valves and other appendages, which are all arranged with a view to utility and economy. They have been long on sale in New York, and are now well known.

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7. For a *Road and Street Gauge;* Randal Fish, city of New York, November 9.

This is an apparatus intended to grade and gauge the surface of the ground in streets and roads, made, however, with a particular view to preparing streets for the reception of wooden blocks. It consists mainly of four pedestals to be placed two on each side, or on the side or middle of the road, and which support longitudinal or string pieces of board, which are attached to the pedestals, so that they may be adjusted to the required level, or inclination; and of a cross piece, the ends of which rest on the string pieces, whilst a gauge board descends from it, which may have its lower edge concave, so as to give the crowning form, in any required degree. By moving this along the string pieces, the grading may be perfectly regulated.

"What I claim is the manner in which I have arranged the three parts, as set forth, so as to adapt them by such combination and arrangement to the attainment of the end for which it is constructed. That is to say, I claim the combining of the side pieces, and the mode adjustable as set forth; with the grading gauge, and with the provisions for adjusting the same. It will be manifest that this instrument may be varied in some particular points, and yet remain substantially the same in its general structure and use; its essential features being its general capability of adjustment, as pointed out, so that by drawing

along that part denominated the grading gauge, its lower edge shall show the precise height, or line, of the surface of the road.

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8. For machinery for *Manufacturing Long Cordage;* William E. Meginnis, city of Philadelphia, November 9.

"The nature of my invention consists in a machine for manufacturing cordage by confining the strand, or rope, firmly in the end of the horizontal spindle that imparts the twist, and after twisting the rope, or a component part thereof, the length of the rope walk, the rope is loosened at the outer end of the spindle, and the operation of twisting is repeated. By this arrangement, ropes of great length, many times the length of the rope-walk, can be manufactured, and thus avoid splicing."

The claim is to "the making the head of the spindle in two parts, which can be separated for the purpose of putting in and taking out the rope, &c., or scarped out for the same purpose, as described."

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9. For an improved manufacture of *Cotton Twine, or Cord;* Jacob Sloat, Strasburg, Rockland county, New York, November 9. (See specification.)

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10. For an instrument for *Measuring, for Cutting Garments;* John P. Barnett, and Francis Story, Cattskill, Greene county, New York, November 12.

This instrument, like many others for the same purpose, consists of elastic strips of metal, duly graduated into inches, and parts, and furnished with sliding and fixed strips carrying measuring tapes, by the use of which it appears likely that all the measurements required by the cutter can be correctly taken. The claims refer by letters to the respective parts supposed to be new.

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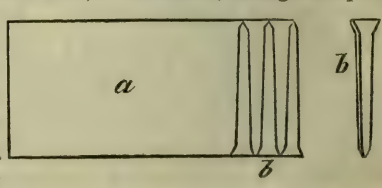
11. For an improvement in *Cut Nails and Brads, and in the Machinery for Manufacturing the same;* Walter Hunt, city of New York, November 12.

"The improvement in the form of said nails, brads, &c., consists in their being cut from hoops or plates of iron, with blunt, wedge shaped, points, and dove-tail, or wedge-shaped heads," as shown in the margin where *a* is a nail plate, and *b*, *b*, the nails. It will be seen that these nails do not require heading, they being cut with a projection on each side, forming what may be called a double brad head.



The cutting is effected by cutters, which are segments of cylinders made to vibrate on their axis; and so far as we can judge from the model, and from the nails and brads cut by the machine, its operation

appears to be perfect, whilst its construction and arrangement are such as to promise durability.

The claim is to "the making the two sides of the head of one nail out of the metal left by cutting the wedge-shaped points of the nails on each side as herein above described; and this I claim whether effected by the above described machine, or any other. Also in the machine above described I claim the shifting of the bed cutters for the purpose and in the manner set forth."

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12. For a *Cooking Stove;* Ebenezer Ferren, Haverhill, Grafton county, New Hampshire, November 12.

This stove appears to be well arranged for governing and directing the draught by means of dampers, and other devices connected therewith, the particulars of which it is not deemed necessary to set forth, and they could not be clearly described without the drawings. In its general form and construction this stove resembles numerous others, in common use.

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13. For a *Straw Cutter;* William A. Staples, Lynchburg, Campbell county, Virginia, November 16.

In this machine there are two knives, or cutters, placed upon the end of a horizontal shaft, which is made to revolve alongside the feeding trough containing the straw. These knives revolve between double rims or circular plates of metal which are sustained at a sufficient distance apart for that purpose. The claim is to "the employment of the double rims, between which the ends of the knife, or knives, are received and revolve, said rims being furnished with cross-bars, which operate as stationary, or bed, shears, sustaining the straw on each side as it is cut by the knife."

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14. For *Scales for Weighing;* George White, Louisville, Jefferson county, Kentucky, November 16.

These scales are to be combined with a counter, above which the dishes, or platforms, for containing the weights, and the articles to be weighed, are to stand; the parts which operate as a beam being within the counter. The claim is to "the method of adjusting the vertical support for the scales by means of the arrangement of the screws, nuts, and loops, as set forth; and the method of raising or lowering the fulcrum and beam so as to bring the scales close to the counter, and out of the way of creating any obstruction by the use of the same." In this arrangement there is not any thing worthy of special description.

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15. For a machine for *Turning the Heads of Wooden Screws and Rivets;* Henry Crum, Clarkstown, Rockland county, New York, November 16.

This machine is necessarily complex, requiring to have its respective parts fully exhibited by drawings, to make their action known. A principal feature of novelty in it is what is denominated the feed

wheel, which consists of a rim projecting out at right angles from a circular disk, or head. This rim is perforated to receive the shanks of the screws, which are fed in within the rim. The holes are countersunk to adapt them to the undersides of the screw heads, and these countersunks are formed in steel plates, and groved so as to constitute cutters. The shanks are received in a clamp chuck, on the end of a lathe spindle, or revolving mandrel, on the outside of the wheel; this spindle being forced back by a sway bar, causes the under side of the heads to be borne against the countersunk cutters; and at the same time a tool is brought up against the top of the screw head, and turns it. All the parts of the machine are self acting, with the exception of the putting the screws to be turned into the feed holes in the wheel, by hand. There are a number of ingenious devices about this machine, some of which resemble, very closely, those employed in that for cutting wood screws, invented and patented by the same gentleman.

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16. For an improvement in *Friction Matches;* John H. Stevens, city of New York, November 16.

The claim under this patent is to the preserving of the matches from accidental ignition by covering them with a coating of varnish, as set forth. Various substances, it is said, may be used for this purpose, but what is used in general "is a little solution of gum mastic, made with spirits of turpentine; or of an alcoholic solution of gum copal or of gum mastic; but other glutinous gums, resins, tenaceous matter, or compounds may be used," &c.

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17. For forming the ignitable matter of *Friction Matches;* John H. Stevens, city of New York, November 16.

The claim is to "the combination of litharge, and the red oxide of lead, or either of them separately, with carbonate of lead, phosphorus, and any glutinous or viscid material on which the preparations of lead will produce a drying effect, and thus render the said compound harder and more durable, retaining its specific character for a longer period than any other compound analogous thereto, and designed for the alike purposes of ignition, all as described."

"I also claim the combination of litharge and red lead, or either of them separately, with the black oxide of manganese, phosphorus, and a glutinous or viscid material on which the preparation of lead will produce a drying or hardening effect, substantially as described."

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18. For improvements in *Friction Matches;* John H. Stevens, city of New York, November 16.

"The nature of my invention consists in dispensing with sulphur, which is employed in the ordinary wood matches or friction lights, to make them more ignitable; and using in lieu of it, nitre or salt petre, by which means the match is not only ignited, but the unpleasant smell of the sulphur is avoided, while at the same time the match being

saturated with the nitre, is converted into a slow match, and continues to burn until consumed. The said matches I call Stevens' fusee segar lights."

The splints are to be soaked in a solution of salt petre, dried, and dipped into the phosphoric composition. The claim is to the combination of the wood so saturated and dried, with any of the suitable phosphoric compounds.

We should offer some animadversions upon the foregoing patents, but believe that the question of the validity of some of the claims is now a subject of legal investigation, and therefore we, at present, leave them to the proper tribunal.

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19. For a *Steam Boiler;* John C. F. Saloman, Shelbyville, Shelby county, Kentucky, November 16.

The patentee of the foregoing boiler obtained a patent on the 17th day of Oct., 1835, for an inverted arch steam boiler, which was, as we believe, constructed upon false principles, and in the *improved* form now given to his boiler, he has carried the same principles to a much greater extent. The plan would require only to be seen by any intelligent practical man to insure its unqualified condemnation. The claim will not lead to a knowledge of the arrangement of its respective parts, and it would waste too much time and paper were we to attempt a description of it. We wish for the sake of the inventor, who appeared to be a gentleman of much cleverness, that the patience and perseverance which he has displayed against numerous obstacles, had been directed to the attainment of some object of utility, and about which he knew something more of first principles. We will merely add, that he uses his inverted arch boiler, and to the junction of each of his arches he attaches a cylindrical boiler, extending from end to end of his main boiler. These are represented as nine in number, and we suppose are to operate as abutments to his arches; these form what the patentee calls a "*nine sided plane cylinder!*"

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20. For improvements in *Cooking Stoves with Elevated Ovens;* John P. Williston and Willard A. Arnold, Northampton, Hampshire county, Massachusetts, November 16.

In this specification there is described a manner of dividing the flue which leads from the fire chamber to the stove pipe, immediately under the top plate of the stove, into three separate flues furnished with dampers, or valves, "for the purpose of directing the draught under either or both of the upper boilers," but this mode of dividing the flues and directing the draught is not claimed, the claim being confined to the manner in which they have combined an elevated oven with a stove, by carrying the heated air compartment entirely across the back end of the stove and allowing the flues from the elevated oven to open into this compartment; by which means the perfect action of the oven is secured although the draught may be directed under one of the upper boilers only.

21. For an improved *Spark Arrester;* Leonard Phleger, city of Philadelphia, November 25.

This spark arrester has been superseded by one since invented by Mr. Phleger, who has, we believe, abandoned that which was the subject of the above named patent. We shall, therefore, let this go among the unsuccessful attempts to accomplish an important object; and should that now used by Mr. P. continue to sustain its present reputation, we will publish the specification, with drawings of the apparatus.

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22. For *Preventing the dragging of Ships' Anchors;* Russel Evarts, New Haven county, Connecticut, November 25.

"My machine consists of a weight of iron or other metal, called a sinker; the base being square, and the height about twice as great as the breadth of the base. In its top is a semi-circle to receive the chain or cable; near the top is a hole to receive a bolt which is to fasten a clasp to the sinker. There are also two rings below the bolt hole, and above the centre, of the sinker."

We were about to furnish the description given by the patentee, to a greater extent than the foregoing, but believe that we can render the construction much more clear by a few words of our own. The sinker is a heavy weight, furnished with a bale, or gallows, at its upper end, and containing a friction roller which is to rest on the chain, or cable, and guide it down near to the anchor. This bale is bolted to the sinker, and can be removed for the purpose of placing it upon the cable, when it is to be raised. The weight, laying upon the bottom, will tend to keep the anchor down, and prevent its dragging. It is proposed to use a similar apparatus to be allowed to descend half way to the anchor, so as to give a spring to the chain, or cable, which will tend to prevent its parting, from sudden jerks. The claim is to the construction and employment of the above described apparatus.

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23. For a *Cooking Stove;* Micah Ketchum and W. A. Wheeler, Boston, Massachusetts, November 25.

In this stove there is a box, or grate, within the fire chamber, which is to be raised or lowered by means of racks and pinions under the hearth, which, however, is not a novel feature in stoves; the claim made is very limited, being to a certain movable, dividing plate, in combination with a partition, which combination, not appearing to be of any special importance, we shall pass over.

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24. For machinery for *Boring the Posts and Tenoning the Rails for Fences;* William H. Shay, city of New York, November 25.

"For boring the posts I use two or more augers placed side by side, and geared together so that by communicating motion to one of them the whole will be made to revolve. The parts to be bored are held by means of what I denominate calliper leaves, which are sustained

upon a sliding carriage upon which the post can be fed up to the augers. The tenoning apparatus consists of cutters placed upon a revolving wheel which I denominate the rotary cutter, or tenoning wheel. Said wheel having a double rim, each of which is furnished with a cutter, or cutters, that sharpen, or tenon, the rails, reducing them all to the same thickness at the ends."

The claim made is to "the combination and employment in such a machine, of the calliper leaves for holding the posts whilst they are being bored; by means of which the range of mortars will all be in a direct line, and through the middle of the stuff, notwithstanding any twist, or other irregularity, which there may be in it."

Specifications of American Patents.

Specification of a Patent for a Blue Writing Fluid, granted to Henry King, *city of Baltimore, Maryland, November 9th,* 1839.

To all whom it may concern: Be it known that I, Henry King, of the city of Baltimore, in the state of Maryland, have invented a new and improved mode of manufacturing blue writing fluid; and I do hereby declare that the following is a full and exact description thereof.

To enable others skilled in the art to make and use my invention, I will proceed to describe its composition and operation.

1st. Take Indigo powdered, 2½ ounces.
" Sulphuric acid 1 lb.

Mix, and stir with a glass rod, occasionally, until the indigo is dissolved.

2d. Take next	Galls, Aleppo	1 ounce.
"	Alum .	3 dachms.
"	Boiling Water	1 pint.

Mix, and let stand twenty-four hours or till the precipitate falls, then filter.

Take mixture first, put it in a glass, or stone, vessel, add sixteen ounces of water. Then gradually add carbonate of lime four pounds, or a sufficient quantity to neutralize the acid, then add seven pints of water, pour off and filter; then add mixture second, and to each ounce of the fluid add one grain of sulphate of iron.

To manufacture the changeable blue writing fluid: take one gallon of the blue fluid already prepared, and add to it No. 2, then to each ounce add nine grains of sulphate of iron, and filter.

What I claim as my invention, and desire to secure by letters patent, is the combination of the ingredients herein specified, so as to form a blue writing fluid, the same being combined in the manner set forth.

Henry King.

Specifications of English Patents.

Specification of a Patent granted to Goldsworthy Gurney, *of the county of Cornwall, and* Frederick Rixon, *of the county of Middlesex, for their invention of improvements in the apparatus for producing and distributing light.*—[*Sealed* 8*th June*, 1839.]

This invention of improvements in the apparatus for producing and distributing light, is applicable to lamps or burners, wherein oil or oleaginous matters, in a liquid state, are the materials consumed for producing the illumination; and our improvements also apply to various kinds of lamps, burners, or lights, wherein the inflammable gas or vapour obtained by the distillation of coal, oil, rosin, asphaltum, or other bituminous, resinous, or oleaginous matters is used, as the material for illumination; such gases or vapours being previously obtained, and then conveyed to the lamps or burners by pipes from a reservoir or gasometer; and consist, in the first place, in improved arrangements and constructions of conducting pipes or tubes and cocks, and jets or burners, whereby we are enabled to introduce into the interior of the flame of such lamps or burners, a stream or jet of pure oxygen gas. The atmosphere or atmospheric air being carefully excluded therefrom, that is, from passing through the burner, or into the interior of the flame. This jet or stream of pure oxygen is applied or given to the flame for the purpose of producing a more intense ignition of the carbonaceous matters, and consequently a more brilliant light than can be obtained where atmospheric air alone, or a mixture of atmospheric air and inflammable gases, are used to cause combustion.

It may be proper here to remark, that we are perfectly well aware that mixtures of air and inflammable gases have been applied to flame for the increased production of heat, and in certain cases to produce light, (in a peculiar description of lamp) which lamps burn the vapour or gas arising from the liquids contained within themselves; we therefore wish it to be distinctly understood, that our improvements have nothing whatever to do with such mixtures of atmospheric air and inflammable gases.

And we are also aware, that pure oxygen has been applied to hydrogen gas for the purpose of producing intense heat for blow-pipe purposes, and on lime for producing light; we therefore desire it to be understood, that our invention only applies to administering to the flames of oil or gas lamps, or burners, a jet or stream of pure oxygen, which, of itself, is not inflammable; but, when applied to the flame in the manner hereinafter described, and at the proper place, will produce intense or bright and clear light, which is caused by the oxygen or supporter coming into contact with the combustible bodies or inflammable gases, at the point of ignition. Therefore, as regards our invention, this jet or stream of pure oxygen may be called the source or cause of the extra light given out; and we have, therefore, in contra-distinction to all other lights, called this "The Olio-oxygen, or Bude Light."

And secondly, our improvements consist in the application and use of peculiar and novel constructions and arrangements of apparatus, whereby flashing or intermitting lights may be caused, or produced, and used as signals for locomotive steam-engines or carriages, and steam or other vessels, or in other situations where they may be required; such intermitting or flashing lights being caused or brought into operation by the passage of streams or bubbles of pure oxygen through flame, when brought in connection therewith, or of inflammable gases when burnt alone without the jet or stream of pure oxygen, such bubbles of inflammable gas being ignited by a small stationary and continuous light; the bubbles of gases being produced by their passing through an inverted syphon, containing liquid, acting as an hydraulic valve. Or the same effect may be caused by the actuating power of machinery or an engine, and may therefore be made capable of indicating the speed at which a locomotive engine or steam vessel is traveling, by the rapidity with which the flashes are repeated.

This effect may be produced by any proper arrangements of mechanism depending on the revolution of the wheels, or the strokes of the engines, or other moving part of the machinery; or in the former case by increasing or diminishing the column of liquid in the inverted syphon, and thus causing a greater or less resistance to the passage of the gas. The same effect may also be produced by altering the capacity of the gas and water tubes, and thereby causing a quicker or slower pulsation of the light.

The construction of the lamp requires two supply pipes—one of which may lead from the street main, or supply gas pipe, gasometer, or oil or gas reservoir, or other source, as the case may be, and the other is the pipe through which the pure oxygen or non-inflammable gas is to pass, or be conducted to the jet or burner,—this pipe may lead from any suitable apparatus for obtaining the pure oxygen, or from a reservoir containing that gas.

The oxygen pipe is connected by an air-tight joint to the lower part of the burner or jet, and passes up the interior thereof, its mouth or exit aperture being on a level, or a little below that of the burner or surrounding flame.

Both of the pipes where inflammable gas is used, must be furnished with stop-cocks, to cut off or supply the two distinct gases. These cocks may be placed separately on the pipes, or they may be constructed with one plug, serving for both pipes, they being connected by air-tight joints to the separate channels. The plug has two apertures bored through it, which are opposite, and answer to the separate channels. The bore of these apertures should be somewhat smaller than that of the passages to allow for wear in the parts, or tightening down the plug.

It is desirable that the apertures should be so arranged, that the oxygen may be let on a little before the inflammable gas, and also shut off a little after it. This is readily done by making the apertures for the inflammable gas, a little smaller than the other.

It is requisite, in order to carry this part of our improvements into proper effect, that the two streams or jets of inflammable gas, and pure

oxygen or supporter, should flow in proper proportions one to the other, therefore the pipes or channels, must be furnished with regulating cocks, or set screw plugs, by which their capacity, or the passage of the gases through them, shall be determined.

When oil, in the fluid state, is consumed for illumination, the pipe or tube, leading from the oil reservoir of the lamp to the circular channel within the burner, is made like a common Argand burner, excepting that the bottom part is closed, so that *no* atmospheric air can pass up the interior. The burner is furnished with a cotton wick, and means of adjusting its height, together with a gallery to hold a glass chimney, as usual. The pipe for the passage of the pure oxygen from the reservoir to the flame is passed through the side of the burner by an air-tight joint, and extends upwards within the burner. The oxygen pipe is furnished with a regulator, plug, or stop-cock, and also with the other cock for the purpose of giving the supply of oxygen to the lamp when it is once lighted, and cutting off the same when it is to be put out. A movable cup is screwed air-tight to the bottom of the burner, which serves for the purpose of stopping up the end of the middle channel, and receiving any deposit from the oil or flame.

The pipes, and the cutting off and supply cocks which, in this instance, have their plugs separate from one another, are turned simultaneously by one handle,—the end of one of the plugs being keyed or counter-sunk into a mortice in the other, so that they must move together, although they may be set up or tightened separately, as may be required.

The second part of our invention contains modifications of our improved apparatus for producing flashing or intermittent lights for signal purposes;—these figures will serve to explain this part of our invention.

There are two ways of obtaining or producing this effect; the *one* is by the *simple action* of bubbles or globules of gases passing through liquids; that is, of inflammable gas, when this alone is used to cause the light, and also of the pure oxygen when the flame of other matters is used in conjunction therewith, the bubbles of either the inflammable or non-inflammable gases passing from the supply pipe through an inverted syphon or chamber, containing a column of liquid, which, acting as an hydraulic valve, (the column being displaced before the bubble can pass,) interrupts the passage of the gases through the pipe, and produces pulsation at the burner. The *other* method is to obtain the same effect by mechanical means, by alternately exposing and hiding, or nearly shutting out the light. The effect of this mechanical operation may be obtained by placing a revolving or moving shade around the flame of the lamp, which shade shall hide the light, except at a part desired, say all but through an aperture in the side of the shade. This aperture being furnished with a reflector to throw the light to a distance, and as the shade and reflector revolve around the flame, it will have the appearance or effect of a flashing or intermitting light to any person placed before or behind it; or the same effect may be produced by alternately opening and shutting the door of a darkened lanthorn containing the light.

Another arrangement of mechanism for producing the same effect, is by means of a supply and cutting-off cock or valve, placed in the gas pipe when the inflammable gases are used alone, or the oxygen when used with the flame of other bodies; which cock is to be alternately opened and closed by some suitable connection with the machinery, and by thus alternately supplying to and cutting off the inflammable gas, or the oxygen, as the case may be, from the flame, produce a flashing, interrupted, or intermitting light.

When the inflammable gas is used for this purpose, there must be a small continuous flame in such position that the bubbles of inflammable gas, as they come in contact with it, will catch fire, and the flashing light thereby be produced; and when pure oxygen is used, the flame of the oil or other matters being kept continually alight, its intensity will be increased or diminished as the oxygen is supplied thereto or cut off therefrom.

One arrangement and construction of apparatus, whereby the method of causing the intermitting or flashing light, by interrupting the passage of the gas or oxygen from the reservoir to the burner or flame, is effected, by means of a column of fluid being placed in its way. A gas pipe is connected, air-tight, to the closed chamber or well containing a given quantity of water or oil; a pipe is carried down to near the bottom of the chamber, where its end is turned up, and opens into the inner tube, which serves as a guide for the bubbles as they arise, and determines the time of pulsation, or passage of the bubbles, by its area; or the same may be determined by the height of the column of fluid.

It will be evident, that if the pressure of gases in the reservoir is properly regulated according to the height of the column of water in the chamber, (or vice versa,) the gases will only be able to escape from the descending pipe through the chamber to the burner in bubbles, or only at intervals, or whenever the pressure of the gases has overcome the weight of the column of water, and forced it out of the descending pipe into the chamber, and thus allowing the escape of the gases to the burner only at intervals. There is a pipe, furnished with a funnel and stop-cock, by which liquid can be introduced into the chamber, and a pipe and cock whereby it can be withdrawn.

This interruption of the flow of the gases can be obtained by several other modifications of apparatus, wherein water or oil is opposed to the direct or continuous flow of the gases, the fluid having to be displaced by the force of the gas before it can pass,—the water or oil returning after each portion of gas has effected its escape; therefore it will not be necessary for us to describe all such modifications of the simple apparatus; but we will proceed to describe one or two modifications, or arrangements, or constructions of the mechanical means to be employed to produce this effect.

Another modification of apparatus, consists of a revolving shade or reflector, placed around the flame of the lamp, which will prevent the transmission of light, excepting through the face thereof; and as this reflector turns around the stationary light, it will throw the rays of light in different directions, and by being enclosed in a dark lan-

thorn, with only one face or part open, will have the appearance of an interrupted or flashing light to any person stationed before or behind it. The jet or burner, is fixed in any convenient situation, and is furnished with all the requisite pipes and tubes for oil or gases; a hood or reflector is fastened to the tube which surrounds the burner, and rests on a shoulder or ledge formed upon it. Rotary motion is to be given to this tube and reflector by any convenient mechanism connected with the machinery, as by a band passed from a pulley, or any rotary part of the engine or machinery.

The same effect of flashing or intermitting light, may be produced by alternately opening and closing a door or shutter in a dark lanthorn, enclosing the flame, and may be done by a suitable machine, having an alternate motion from any part of the machinery.

Another mode is to cause the intermitting or flashing to be produced in a stationary lanthorn and continuous light, but in which the supply cock of the oxygen pipe is alternately opened and closed, whereby the intensity of the flame is increased or diminished, as the admission of the oxygen is allowed to pass to, or is cut off from the flame.

An oil lamp, adapted for this purpose, may be furnished with a movable reservoir of oil and cotton wick burner in the ordinary manner, and a pipe or channel for the pure oxygen, leading from a reservoir to the top of the burner into the interior of the flame. The part of this pipe, between the lamp and the cock, may be made either of metal or flexible material, as circumstances may require. A supply and cutting-off cock or valve, in this instance, is intended to have a rotary or interrupted rotary motion given to it by means of the pulley on its plug; but a common slide-valve or cock, alternately opening and closing by means of a reciprocating or alternating motion, obtained from the machinery, may be placed in the same situation, and will produce the same effect. A lamp or lanthorn may be fixed in any required position, and when flexible tubes are used, may be made to take on and off its fittings when required. The seat or bed of the cock or valve is to be fixed in any convenient situation on the locomotive engine or vessel, and a rotary or alternating rotary motion given to it, by means of a band or strap passed to a pulley, from any revolving part of the machinery, or by a toothed rack connected with and actuated by any part of the machinery, which has a regular alternating or reciprocating motion; or the same effect may be produced by an eccentric, connected by a rod to a crank, all of which modifications or arrangements are so well understood, that it is not necessary for us to describe them.

Having now described and ascertained our improvements, and the manner of carrying the same into effect, we wish it to be understood, that we do not intend to confine ourselves to the precise forms, or arrangements of construction of apparatus or mechanism, herein shown, as the same may be varied to suit different circumstances; and we claim as our invention, secured to us by the above in part recited letters patent, as our "improvements in apparatus for producing and distributing light," first, the arrangement and construction of pipes or tubes connected with jets or burners, and furnished with suitable

stop-cocks or valves, whereby a jet or stream of pure oxygen is administered or given to the interior of the flame of either oil-wick or inflammable gas lamps; and, in the second place, we claim, as our improvements in apparatus for producing and distributing light, the improved arrangement and construction of apparatus or mechanism, whereby we are enabled to produce an intermitting, or interrupted, or flashing light, to be used as signal lights for railway, telegraphic, and navigation purposes, either by passing the inflammable gas in bubbles, when it is used in connection with a small fixed continuous light, or the pure oxygen when used in the interior of flame, obtained from the combustion of other matters, the pressure of the gas overcoming a column of fluid, and thereby causing pulsation or passing of bubbles, before it can escape to the burner or flame; and also the improved apparatus or mechanism, whereby we obtain the same effect of intercepting the passage of the gas, either inflammable or non-inflammable, to the fixed or continuous flame, by alternately opening and closing the valves, cocks, or taps of the gas pipes, and thereby causing an intermitting or interrupted light; and also the improved apparatus or mechanism, whereby we obtain the same effect, by the revolving or moving shade or reflector surrounding the light, as hereinbefore described.* Lond. Jour. Arts & Sci.

Specification of a Patent granted to James Horne, *of Clapham Common, Surrey, gentleman, for improvements in the Stuffing Boxes of Lift Pumps.*—[Sealed 3d September, 1839.]

The peculiarity of this invention consists in combining in each stuffing box two cupped leathers inverted, with their bases towards each other, and having between them a flat disc of metal; the flanch of the lower cupped leather rests upon a projecting ledge, cast upon the inside of the stuffing box, and that of the upper cup is forced down by a similar projection in the cup of the stuffing box, in such a manner that, on the rising of the piston rod (which passes through both the leathers, and the metallic disc,) the lower leather will resist the pressure of the fluid from below, and the upper leather that of the atmosphere from above, on the return of the piston rod. Mining Jour.

Specification of a Patent granted to Thomas Farmer, *of Gunnersburg House, near Acton, Middlesex, for improvements in treating Pyrites and other matters, to obtain sulphur, sulphurous acid, and other products.*—[Sealed 25th August, 1839.]

This invention consists in treating pyrites or other substances containing sulphur in a state of combination, and by causing them to burn in a furnace without the aid of fuel, so as to disengage the sulphur which they contain, and form thereby sulphurous acid gas, or sulphur in its simple state. The furnace having been heated in the first instance

* Figures descriptive of the apparatus, are given in Newton's Journal and Repertory, for September 1840.

with coals, or with burning pyrites, is afterwards fed with pyrites introduced in the doorway; and the further advantage of this invention consists in the mode of charging the furnace, regulating the admission of the atmospheric air, and the withdrawing of the decomposed materials.

The furnace has two chambers, one above the other; the doorway of the upper one is in front, and the lower chamber has its doorway behind. The pyrites, with the fuel, is first placed in the upper chamber, and is lighted in the ordinary way, and whatever particles escape through the upper grating, the lower furnace will consume, which residuum is removed when required, and as soon as any pyrites in the upper furnace form into clinkers, such clinkers are removed, and fresh pyrites are thrown on to the burning fuel, which yields its sulphurous acid gas to be passed off through a chimney, or channel, into a chamber, where it is treated as sulphur heretofore.

When it is designed to treat for sulphur, rather than for sulphurous acid gas, the door must be closed entirely, and only sufficient air must be admitted through a vent, in order to support combustion; and to facilitate the sublimation of the sulphur, a vapour of water must be passed from the ashpit to the burning pyrites, which impart their sulphur to be condensed in the ordinary way adopted. Ibid.

Specification of a Patent granted to James Beaumont Neilson, *Glasgow, for certain improved methods of Coating Iron, under various circumstances, to prevent oxidation or corrosion, and for other purposes.*—[Sealed 29th August, 1839.]

The inventor claims the method of coating or covering iron, &c., by means of copper, or alloys of copper, with zinc or tin. The copper or alloy is brought to that minute state of division in which it is obtained by precipitation from its solution, or it may be used in a granulated state. In order to cover cast-iron, sprinkle a thin coating of granulated, or other fine copper or alloy over the surface of the mould, to which may be added borax, or other flux, to facilitate the spreading or diffusion of the metal. Thus, when the molten iron is poured into the mould, the copper or alloy will be fused, so as to cover the casting, and render it secure against oxidation or corrosion.

If malleable iron is to be coated, put a covering of the pulverised copper or alloy over the upper surface of the iron, while it is being heated, and the borax, or other flux, will soon cause it to spread over the heated part, which should be plunged into water, to detach the scale of oxide that forms upon it. Ibid.

Specification of a Patent granted to Gerard Ralston, *merchant, Tokenhouse-yard, London, for improvements in Rolling Puddle Balls, or other masses of Iron, by employing a peculiar machine, for the purpose of compressing the iron into a state called bloom, preparatory to its being rolled into plates, or operated upon by tilt hammers.*—[Sealed 22d August, 1839.]

The machine consists of a rolling cylinder, revolving on an axle within a strong iron frame; a toothed wheel is attached to each end of the cylinder, which is acted upon by pinions, to give it the necessary rotary motion. A segmental piece of iron firmly fixed to the frame, embracing the cylinder, but in an eccentric position to the periphery of the cylinder; between this segmental piece of iron (which is semi-circular at the entrance) and the cylinder, the mass of iron passes in the form of a ball; a rotary motion being given to the cylinder, the mass of iron decreases in diameter, and increases in length, until it is delivered out at the bottom of the machine in the form of a roll.

The inventor claims, first, the entire machine.

Second, the mode of working the same in a horizontal position, if it should be found more convenient.

Third, by making masses of iron into balls, and then into rolls by one machine, either as the above or by substituting a piece of flat iron for the segmental piece, and having a second piece of iron wedge-shaped, working on an axle in conjunction with the flat piece, which might be made to produce the same effect.

Ibid.

Specification of a Patent granted to John Wilson, *Liverpool, lecturer on chemistry, for improvements in the manufacture of Carbonate of Soda.*—[Sealed 19th August, 1839.]

This improvement consists in using bicarbonate and sesquicarbonate of soda in preparing common carbonate of soda. The inventor obtains carbonate of soda from sulphuret of sodium, by adding one equivalent, or eighty-five parts of bicarbonate, to one equivalent, or forty-eight parts of sulphuret of sodium.

He also obtains carbonate of soda from the black ash usually produced by decomposing sulphate of soda, by adding bicarbonate of soda in relative proportions to the caustic and carbonate of soda contained in the black ash.

Claims the use of bicarbonate of soda, and sesquicarbonate of soda, in obtaining carbonate of soda from sulphuret of sodium, and also from the black ash obtained by decomposing sulphate of soda in the usual manner.

Ibid.

Progress of Practical & Theoretical Mechanics & Chemistry.

On Bone and its Uses in the Arts. By A. Aikin, *late Secretary of the Society of Arts, London.*

Most animal bodies are composed of soft and hard parts; of the latter, some are hard only when of a certain thickness, but when thin are tough and more or less flexible and elastic; such as the horns of all mammalia (except of the stag tribe;) the claws of the lion and tiger; the talons of the eagle; the horn of the rhinoceros; the coriaceous covering of tortoises and crocodiles; and the scales of fishes.

All these, by exposure to a gradually increasing heat, soften, enter into pasty fusion, give out the odour of burnt feathers, burn with jets of flame, and are consumed, leaving behind a very small proportion of earthy matter. 500 grains of horn leave not more than from 0.25 to 2 of phosphate of lime. Boiling-water, after long action, takes up from most of them scarcely any quantity of soluble matter, but they are perfectly soluble in caustic alkali, and the solution gives, with acids, a curdy precipitate. They are considered, therefore, as composed of condensed membrane, or, in chemical language, of albumen.

Other hard parts are rigid, considerably harder than the former; when dry, and in many cases when wet, they are very slightly flexible or elastic; and when struck by a hammer, or when bent beyond their power of resistance, break short with a splintery surface. When exposed to a red heat, with access of air, the membranous or animal part is destroyed; but the earthy part remains in sufficiently abundant quantity to retain the external form, and generally the internal structure, of the entire substance, of which calcined bone and calcined oyster-shell are examples. The original hardness of these parts is owing to the abundance of earthy matter that enters into their composition. When such parts are on the outside of the body, they are called, in common language, shells, horns, teeth, according to their position; and the uses for which they seem intended. When they occur within the body, they are called bones.

If, however, we restrict the term bone to its common meaning, we shall exclude the horns of the stag kind, and the substance which forms the body of most teeth, both which are truly bone, and shall include some substances, such as cuttle-fish bone, which is truly shell.

It is, therefore, necessary to enter into a more minute examination and comparison of these hard substances, in order to ascertain which of them are shell and which bone; and, as the result of our inquiry, we shall probably find, with respect to this class of natural bodies as with many others, that although the two extremes of the series are readily enough distinguishable from each other, yet they approach by such insensible intermediate gradations, as to render it impossible to say where the one begins and the other ends.

There is a class of shells comprising most of the univalves, which are harder than other shells, and when broken, present thick, parallel layers, the layers themselves having usually a finely fibrous structure

at right angles to the external surface. These fibres may often be seen to be nothing more than the transverse section of thin transparent parallel lamellæ, which, when viewed on their broad surfaces, often exhibit the usual natural joints of calcareous spar. When such a fracture is viewed by the naked eye, it has a good deal the appearance of porcelain,—whence their name of porcellanous shells. When carefully cleansed from all remains of the animal which inhabited them, they give out scarcely any perceptible odour on being made red hot, though their colour becomes somewhat grey. When unaltered they dissolve in dilute acid with much effervescence of carbonic acid gas, and a few hardly appreciable gelatinous flocks remain undissolved. These latter, on being collected and washed, give out, when heated, a faint odour of burnt animal matter, and become black before they are consumed. By proper chemical tests the soluble part of the shell is proved to have been carbonate of lime or chalk, the particles of which were cemented together with a very minute portion of animal mucus.

Another class of shells is the nacreous, so called from the varying and iridescent colours that they exhibit, resembling those of nacre, or mother-of-pearl; this very substance being, indeed, only a part of a nacreous shell.

These, when heated in a crucible, give out the odour of burnt feathers, often with a perceptible smoke, become of a dark-grey colour; and when submitted in this state to the action of acids, there remains undissolved a notable quantity of charcoal. In the recent state they effervesce with weak acids; and when the calcareous matter has been removed, there remains a series of flexible, membranous, or semigelatinous lamellæ, lying parallel to one another, and representing the form of the entire shell. These lamellæ have sometimes a distinctly fibrous structure, parallel to the surface of the shell; and though quite flexible while moist, they shrivel on drying, and become hard like horn,—a substance to which they bear the greatest possible analogy. The nacreous shells, therefore, are always very finely lamellar in structure, and are represented by some as composed of alternate layers of membrane and carbonate of lime; but the more probable opinion is, that the calcareous matter is intimately mixed with the membrane, rather than distinct from it. These shells increase in size, in order to accommodate themselves to the growth of the animal, by the deposition of new and larger layers from within; and hence the external surface is covered by concentric furrows or wrinkles, marking the outer margin of each successive layer.

Between the two classes of shells that I have described are others, the minute structure of which I am ignorant of, but which differ considerably in the proportion and condition of their membranous ingredient.

Thus it appears that all shells, how much soever they may differ from one another in structure, agree in containing carbonate of lime as their only earthy ingredient; and an animal substance, nearly resembling if not identical with, horn or membrane, as their consolidating or agglutinating ingredient.

Exactly the same substances, namely, carbonate of lime and mem-

brane, in various proportions, form the constituent materials of the madrepores and other hard corals.

On examining the hard covering of aquatic crustaceous animals, such as the crabs and lobsters, we find, after the action of acids, that there remains a whitish, soft, elastic cartilage, which represents the original shape of the part, and that the acid solution not only contains lime that had been in the state of carbonate in the original shell or covering, but likewise phosphate of lime, although in smaller proportion than the carbonate. The presence of this earthy salt forms an essential difference in chemical composition between proper shell and the covering of the crustacea, which latter substance may thus be considered as holding an intermediate position between shell and bone.

Some of the corallines, chiefly those belonging to the genera *Gorgonia* and *Antipathes*, approach still nearer in chemical composition to bone; and, indeed, are hardly to be distinguished from it, their earthy part being phosphate of lime with only a small admixture of carbonate, their figure and structure being represented by dense membrane, and, when boiled, they give out a notable quantity of true jelly, which, like other kinds of animal jelly, has the property of forming a precipitate with infusion of galls or of oak-bark.

The proportion of membrane in these substances varies considerably, so that while one species almost exactly agrees in composition with the horn of the stag, others contain so much membrane in proportion to earthy matter, as to be nearly identical with the bone of the cartilaginous fishes.

If a piece of true bone, in an unaltered state, be put into weak acid (muriatic acid, on the whole, is the best,) a moderate degree of effervescence will take place, showing the presence of some carbonate. By a continuance of this process for some days all effervescence and chemical action will cease; what remains undissolved will still represent the size and form of the original bone; but it will be semi-transparent, will exhibit a distinctly cellular structure, will be soft, flexible, and, to a certain degree, elastic. If, after being washed, it is boiled in water, it will be found to be in part soluble; and the solution, when boiled down to a proper consistence, will become viscid, and will gelatinize on cooling, and by drying will be brought to the state of hard glue. This jelly, when again dissolved in water, will become curdy and will give a grey precipitate with nutgall, and will exhibit all the other physical and chemical properties of gelatin; the remaining portion insoluble in water will become hard and somewhat brittle by drying, will burn in the fire like a piece of horn, will dissolve in caustic, fixed alkali forming a saponaceous liquid, and will show all the other properties of albumen or membrane.

The acid in which the bone was first steeped will give an abundant white precipitate of phosphate of lime by means of caustic ammonia, and will give a much smaller precipitate of carbonate of lime by carbonate of ammonia. Thus, by the action of a few simple re-agents, the essential constituents of bone are demonstrated. In this summary I have taken no notice of the oil or fat which is contained in the internal bones of all mammiferous animals, because it seems to be by no

means an essential part of bone; the horn of the stag and of other animals of the same kind being entirely free from it. On this account it is that hartshorn jelly, made by boiling the shavings of stags' horn in water, is often recommended to persons of very weak digestion in preference to other animal jellies, as being absolutely free from oil; for, though hard fat is incapable of dissolving in jelly, yet the softer oily fats will combine with it in small proportion.

But, although it is impossible to draw any marked line of chemical distinction between true bone and the indurated membranous textures that I have already mentioned, yet the mode of their origin furnishes a real and very important difference.

Of the organization of coralline bodies, indeed, we know nothing; for scarcely any of them have been even superficially examined when alive, and, when dried, all trace of structure in the soft parts is completely obliterated.

But with regard to the production of shell, both in univalve and bivalve testacea, we are certain that it never, as such, forms a constituent part of the living animal. A viscid fluid is secreted by certain organs; and it is only when discharged from the body that it assumes the consistence and other characters of shell: therefore, although we may with perfect propriety speak of the structure of shell, as we speak of the structure (that is of the mechanical arrangement of constituent particles) of a crystal, it would be a gross misapplication of terms to speak of the organization of shell; this latter meaning such an arrangement as is compatible with and necessary for the performance of vital functions. Shell is essentially a dead body, or rather one which never was alive; for though naturalists and collectors well know the difference between what they call a dead shell and another, they mean by this expression merely to point out the difference between an empty shell and one, the inhabitant of which was alive at the time of its capture.

The way in which the hard covering of the crustacea is annually formed (for these creatures change their shell every year) has not been sufficiently examined to ascertain whether it is at first a mere exudation which hardens out of the body of the animal, or is an induration of the cuticle by the deposition in its pores of calcareous matter conveyed thither by proper secreting vessels. If the former is the case, the shell of the crustacea is analogous to that of the testacea; if the latter, it some what resembles bone in the mode of its formation.

With regard to bone itself, there is no doubt that it is as truly organised and vital as any other part of the body. As soon as the rudiments of a young animal can be distinguished before its birth, the place of the future bone is indicated by a soft or semi-fluid matter inclosed in a delicate membrane; by degrees both the membrane and the matter which it incloses become more dense and cartilaginous; opaque white spots then appear, which soon after are penetrated by vessels carrying red blood; the deposition of bone then begins, and at the same time the cartilage seems to be gradually replaced by membrane. The rudimental bone, which at first was solid, now begins, at least in the long bones, to exhibit an internal cavity or hollow axis; thus showing that, while fresh matter is continually depositing to supply the growth of the

bone, that which had been already deposited is removed, and that this latter process takes place in the interior of the bone at a greater rate than the other does. The activity of the two vital processes of deposition and removal, or, to speak in technical language, of secretion and absorption, is, of course, proportioned to the rapidity of growth; so that, during the early periods of life, the bones participate with the soft parts of the body in the continual change and flux that is taking place within them. When the full stature of the animal is attained, these two actions probably diminish in rapidity, but still are kept up sufficiently to preserve the life of the part. As old age approaches, the removal of the earthy ingredient of bone seems to become more difficult; its proportion, therefore, to the membranous ingredient increases, and hence the bones of old animals are harder, of greater specific gravity, and more brittle than those of younger ones.

That very remarkable natural process, namely, the annual renewal of the bony horns of the stag and other animals of the deer tribe, is, perhaps, the most striking example and illustration of the circumstances necessary to the formation of bone. These horns arise from a short process or pedestal projecting from a bone forming the upper part of the skull, and called the frontal bone. At the season of the year when the horns are about to be renewed, an increase of vital action takes place in the bone, and a faint red line, indicating the presence of blood-vessels, will be perceived in making a longitudinal section of the bottom of the horn and the base on which it stands; the situation of this red line, indicating precisely the boundary between the dead horn and the live bone; absorption of part of the bone takes place, which loosens the adhesion of the horn to it, in consequence of which this latter falls by any accidental shock which it receives. The spongy tissue of blood-vessels, which may now be seen covering the end of the bony base, is soon entirely covered by the growth of the external skin; and this may be considered as terminating the first part of the process. Soon afterwards a small tubercle arises from the end of the bone, and presses upwards the skin which covers it; the tubercle rapidly elongates, the skin extends with it, and in the course of a few weeks it has assumed the size and shape of the future horn; in this state it is covered by the attenuated skin, which latter has pushed out an abundant growth of short fine hairs resembling the pile of velvet. Beneath this skin is a layer of blood-vessels, the diameter of some of which is equal to that of the little finger; these rest on a thin layer of dense membrane, of the same nature as that which covers ordinary bones, and called the periosteum; and within the periosteum itself is a flexible cartilage, penetrated in all directions by ramifications from the blood-vessels already mentioned.

In this state the future horn is very tender and exquisitely sensible, it bleeds when the skin is broken, and the animal often suffers much in this part from the bites of gadflies and other insects. When the cartilage has attained its full growth, ossification begins by the deposition of phosphate of lime, and goes on till the bone or horn has acquired its complete hardness. During this process, a ring of bony beads has been forming at the base of the horn, in the intervals be-

tween which the main trunks of the blood-vessels lie; these beads enlarge by the continual addition of bony matter, and in so doing compress the adjacent sides of the blood-vessels, and thus diminish the supply of blood; at length the sides of these vessels are quite squeezed together, circulation ceases, and all the soft parts die, shrivel, and dry up, and are rubbed off by the animal against the bough of a tree, leaving the dead bone, or horn, attached by its base to the frontal bone; till, after some months, the time for shedding it again comes round, when a repetition of the processes already described takes place.

Bones, even of the same animal, vary much in structure and in hardness, and no doubt in the relative proportion of their component parts, according to the situation in which they are placed, and the use to which they are put. Thus the shafts of the long bones, being wanted chiefly for support, are more or less in the form of a hollow cylinder, and the texture of the bone itself is dense and compact. Those parts of bones that form the joints or articulating surfaces by which one is hinged on to another require a considerable space for the joint, and for the attachment of ligaments; but as a degree of strength proportioned to its thickness is not wanted, the structure becomes cellular. A similar structure is observable in the flat bones, which consist of two thin parallel tables of dense bone, having a cellular part interposed between them. Hence, in utensils made of bone, the compact cylindrical ones are generally employed, both as being stronger and admitting of a more uniform and higher polish.

The bones of animals belonging to the same general class of nature are commonly observed to have certain points of general resemblance, by which they may be distinguished from one another, and are applied by man to various uses corresponding with such differences. Thus, the bones of fishes are softer, more flexible, and contain a much larger proportion of jelly and membrane, or, which comes to the same thing, a much smaller proportion of earthy matter, than those of the mammalia or warm-blooded quadrupeds; and the bones of these latter, comparatively dense and hard as they are, fall considerably short in density and hardness of the bones of birds, which, however, are generally too small and thin to be applied to much use in the arts.

Bone undergoes, much more slowly than the soft parts of animals do, the process of spontaneous decomposition; meaning, by this term, that disintegration of a compound which takes place either by the chemical re-action of its ingredients on one another, or by means of air, moisture, and common temperatures. The bones of a human body buried in a church-yard are, perhaps, mostly consumed in twenty or thirty years; yet under favourable circumstances they will endure for a much longer time with but little change. Thus, in the charnel-house at Morat in Switzerland, there still remain many bones of the soldiers of Charles the Bold's army, who perished there in 1438, being 401 years ago. When Sir Christopher Wren was rebuilding St. Paul's Church after the great fire of London, the workmen in digging for the foundations came to the floor of a Roman temple, dedicated to the goddess Diana, on which were the horns of stags and

bones of other animals. Tombs of the ancient inhabitants of this island are occasionally opened, in which are found bones that have been deposited there during many centuries; and I have the pleasure of exhibiting to you part of a carved bone spoon (discoloured and passing to a state of decomposition, it is true), which was found in an Etrurian tomb at Vulsinum, in Italy, possibly as ancient as the foundation of Rome. In the valley of the Lea are many peat mosses, the remains of ancient forests, now covered to the depth of several feet with alluvial silt. Many of these have of late years been dug into, on occasion of making docks and other excavations; and in or upon them have been found the osseous remains of boars, stags, and other animals, which have lain there from the time that these creatures roamed wild in the immediate neighbourhood of London. Not only the remains of individuals belonging to species now extant are still found, after being buried for centuries, but the bones of species now extinct, and many of which, judging from the habits of species nearly allied to them and now living, can scarcely exist except in warm climates, are found abundantly in the British islands, and in all parts of Europe. Remains of a large animal of the ox tribe are found in Essex. Elephants, hippopotamuses, and rhinoceroses, differing in many respects from any now known to exist, are also found in the same county, and in other places near London. Hyænas and tigers, also, of extinct species, occur in the cavern of Kirkdale, in Yorkshire, and in other caverns in the west of England; and in certain caverns in Germany are found the remains of two species of bear, differing, in some anatomical details, from any known living species of the same genus. There is no evidence that the human race was contemporary with these creatures; and yet, notwithstanding the enormous length of time that must have elapsed since the deposit of the animals in the places where their bones are now found, many of them are in a state apparently of almost perfect preservation. Membrane and jelly still remain in the bones; but the oil or fat, being uncombined with earthy matter, has disappeared.

In what I have hitherto said, I have alluded very slightly to the use of bone in the arts, which was the ostensible object of the present illustration; for I confess that I have not unwillingly been tempted to enter into the preceding physiological and other details, in order to relieve the dryness of mere technical description. In what remains I shall treat of the practical part of my subject, beginning with an inquiry into the use of bones as articles of food.

All animals that eat flesh will likewise eat bones, provided they are of a size to be easily crushed and masticated by them; so when a lion or tiger has taken one of the smaller antelopes, I presume he devours many of the bones along with the flesh, leaving only the spine, skull, and horns. But when he has pulled down a horse or buffalo, the case is different; the flesh alone of the animal is sufficient for an ample repast; the leg-bones and ribs are not to be cracked by a single straightforward crush of the jaw; and the spine, from its awkward shape, as well as by reason of the strong ligaments by which its parts are bound together, may well resist the lazy efforts

of an animal already satiated with food,—not to mention that the great length of the canine-teeth in the larger animals of the cat kind, as well as the small number of their grinders, render the act of gnawing both difficult and unnatural to them. The half-picked carcass, therefore, falls to the share of the wolves and hyænas. The former, after tearing off the ligaments of the joints, proceed to separate the bones from each other; and then, by gnawing, grind off the softer parts of the spongy articulating surfaces, in which they find a wholesome food. The hyæna, with far greater strength of jaw and of teeth than any other animal of his size, goes to work bodily, especially on the ribs and other flat bones, crushing them into large, splintery fragments, and swallowing them in this state, without fear of being choked or injured by their sharp points and rough edges. These two animals, therefore (including the dog, as a sub-species of wolf), are eminently the bone-eaters; the membranous and gelatinous matter of the bone, being dissolved out by their gastric juice from the earthy portion, undergoes the usual process of digestion; while the latter, apparently unaltered, passes through the intestinal canal, giving to their excrements the well-known appearance of half-dried mortar, and may afterwards be applied to all or any of the purposes for which bone-earth is used.

Man, the cooking animal, extracts nutriment from bones in a different way. When very hard pressed, indeed, he can stave off famine for a while, as Captain Franklin and his party did more than once in their exploratory arctic expedition, by taking bones, which even the wolves had left, and scorching them so as in some degree to subdue their hardness; and thus render it possible to gnaw and masticate them as a succedaneum for food, or, at least, as some alleviation of the agonies of famine.

But the animal matter of bones is best extracted by hot water. Every housekeeper knows that the nutritive quality of meat soups is much increased by boiling the bones together with the meat. In this way, however, only a small proportion of the food contained in the bones is made available; for part of the gelatin is with difficulty, and the membranous part is not at all, soluble in common boiling water; much even of the fat is locked up in cells of the bone, from which it cannot escape except these cells are broken into.

The solid part of the long bones contains very little soluble matter; it would therefore, in most cases, be a matter of economy to exclude them; the advantage to be derived from them by ordinary treatment not being equal to the value of the fuel which they would require. It is from the enlarged extremities of the long bones and their articulating surfaces that the principal supply of nutritive matter is to be derived; these parts, therefore, should be sawed off from the rest and broken into pieces. From the bones of young animals thus treated, boiling water will, in two or three hours, extract the whole or nearly the whole of the soluble matter; but, in the bones of older animals, the gelatin seems to be in a state of condensation approaching to that in which it exists in skin, and therefore requires the long-continued action of boiling water for its separation. By way of experiment, I

had the leg-bone of an ox sawed longitudinally and boiled for three or four hours. At the end of this time, the whole of the fat and mucus had been extracted, with part of the jelly. On applying the finger to the cellular part of the bone when wiped dry, I found the surface to be considerably sticky, and, on examining the cells, I found many of them completely filled with a transparent substance scarcely viscid, but much resembling pieces of glue that had been put to soak in cold water; by which, as every one knows, the glue swells exceedingly by absorption of the water, without, however, becoming viscid. A second boiling for three or four hours in fresh water dissolved out a considerable proportion of the gelatin; but still the surface of the bone remained sticky, many of the cells had a glazed surface, and, even after a third repetition of the boiling, only a few even of the superficial cells were quite empty. It is evident, therefore, that we cannot avail ourselves, with any regard to economy of fuel, of the whole of the nutritive matter contained in bones by the action of boiling water applied in the common way. But by means of a digester—that is, a boiler with a steam-tight cover and a safety-valve—we can without hazard raise the temperature of water from 212°, its boiling point in the open air, to 270° or 280°. At a less heat than even the former of these, not only the condensed gelatine but also the membranous part of bones is dissolved, if the bones have previously been reduced to small pieces, and the undissolved residue will be found to be a friable crumbling mass, with scarcely any remains of animal matter. It appears that bone soups are thus prepared at present at some of the hospitals and military head-quarters in France, and memoirs have been published, stating the advantage of making a collection of dry bones as part of the provisions of a garrison in case of siege, being a kind of food scarcely susceptible of decomposition or of destruction by rats or mice, and which would require no other magazine than simply making them into stacks and covering them with a roof of thatch or any other material. Complaints, it is true, are made of the burnt flavour which such soups are liable to have, and perhaps it may not be very easy to regulate the temperature of the water in the digester so as to avoid the empyreumatic flavour, and at the same time completely to extract from the bones the animal matter. On this account it is that another scheme has been proposed, namely, to put the bones, after soup has been made of them by boiling in the common way, into a stone trough, and then pour on them very dilute muriatic acid. By repeating this process in the cold a sufficient number of times, the whole of the earthy matter will be dissolved out, and probably without much, if any, injury to the animal matter, which will remain in the form of a porous membrane; by repeated percolations of water the acid would be washed out; or, if a little should remain, a last sprinkling with a solution of carbonate of soda would convert the acid into common salt. The membrane being now dried in the air will acquire a horny hardness, by which it will be rendered almost incapable of spontaneous decomposition, and would probably be found to be much more easily convertible into palatable human food by the common processes of cooking than the entire bone.

The plan, to say the least of it, is plausible, provided muriatic acid may be had, as it now may be, at a very small cost.

There is, however, a whole class of animals, the bones of which, without any chemical preparation, are presented to us by nature in a state capable, with very little trouble, of being converted into nourishment. I mean the whole class of fishes. The bones of these creatures contain so little earth, that, by drying and grinding them, a powder is obtained which, when made into cakes with meal, has proved a valuable resource to the people of Norway and Sweden in times of scarcity; and some of them, by simply browning on a gridiron, become quite friable, and, when treated with a proper quantity of pepper and salt, form a very palatable article of food.

Trans. Soc. Arts and Man.

Steam Navigation in France.—Extracts from the Report of Count Daru to the Chamber of Deputies, in the name of a special Commission intrusted with the examination of a projected law relative to the establishment of Steam Packets between France and America.

The form, dimensions, and power of steam-boats evidently depend on the service to which they are destined. They were not long merely employed in the ascent and descent of rivers, but soon the limits of steam navigation were enlarged, increasing the power of the engines from 20 to 80, 160, 200, and 250 horses, it became possible to extend the field of their employment to venture on the sea with them. Towing boats, which had been constructed in a few ports, soon threw a light on the superiority of the new system, by bringing out large vessels, weather bound and condemned to inactivity, and drawing them in their wake with a facility which seemed to defy the elements. From that day the bright days of sail-navigation, which, till then, was looked upon as the *chef d'œuvre* of human understanding, were eclipsed. Now vessels were started on every coast. Regular and rapid communications linked together every important town, such as Havre, London, Dover, Hamburg, Rotterdam. This was the forerunner of more daring attempts.

In 1819, a vessel from the United States, "the Savannah," had crossed the ocean from Liverpool to New York,* partly by wind and

* The first Atlantic steam voyage of the "Savannah" was from Savannah, Georgia, to Liverpool, and *not* "from Liverpool to New York." We find by her log book, which is now in possession of the American Philosophical Society, and which appears to have been kept with great precision, that she left New York under the command of Captain Moses Rogers, a native of Connecticut, on the 28th of March, 1819, and arrived at Savannah on the 6th of April; where the captain found it necessary to remain some days to take in fuel and put things in order, after which he sailed for Liverpool, where he arrived on the 20th of June.

About the middle of July he left Liverpool for the Baltic, reached Elsineur on the 9th of August, and left it on the 14th; put into Stockholm, and left it on the 5th of September; went to Cronstadt, and from thence to St. Petersburgh. Sailed again on the 10th of October, went to Copenhagen, and finally returned to Savannah, and from thence went to Washington.

partly by steam. America, then, had the lead again in daring to apply Fulton's machine to long voyages, and this is the more remarkable, that it has always had but few steam-boats on sea service. This first essay was not repeated until in 1835, when the English undertook the passage from Falmouth to the Cape of Good Hope; the Atlantic, provided with an engine nearly similar to that of the Savannah, accomplished in 37 day a distance of 2,400 nautical miles. The Berenice, the Medea, the Zenobia, performed passages of different lengths on the coast of Africa, and in the Indian seas. All these boats were English. In the Mediterranean, steamers of different nations, Neapolitan, Sardinian, Austrian, French, crossed from one port to another. Lastly, our service of steam packets from Marseilles to Alexandria was established, and threw open to us a new access to the East. The passage to Constantinople, which was sometimes forty-five days in duration, was thus reduced to thirteen and a half days.

These numerous experiments gave rise to the idea that, by the aid of steam, it was possible to accomplish the distance between Europe and the United States. The difficulty of carrying the necessary quantity of coals for the consumption of an engine acting, without interruption, from one shore of the ocean to the other, during a space of from fifteen to twenty days, was no longer an obstacle. It had been discovered that the consumption of combustible did not increase in the same ratio with the power of the motors,—that an engine of 250 horse power, for instance, was far from burning twice as much fuel as was necessary for an engine of 125 horse power; that, moreover, certain parts of the mechanism might be simplified in such a manner as to take up less room, and consequently, leave more space at disposal for the accommodation of passengers or merchandise. From this time operations were commenced, and on the 4th of April, 1838, the first experiment was tried. You are all acquainted, gentlemen, with the result. You all beheld the enthusiasm excited by the success of the vovage undertaken by the Sirius, fifteen days had been sufficient for its passage. Scarcely had this vessel arrived in the port of New York, when it was joined by the Great Western, which started from Bristol on the 8th of the same month, after a passage of fourteen days.*

Henceforth the problem was solved. America was nearer the European continent by half the distance which formerly separated them. There could be no more doubt concerning it; the events which have since occurred have ratified these first expectations.

The Great Western has crossed the Atlantic twenty-eight times during the period of the fourteen months just elapsed without accident, maintaining an almost uniform speed, of which the average time was

* The length of this boat is 236 feet, its depth 23 feet 3 inches, its width outside the paddle boxes 58 feet 4 inches, draught corresponding to the load, 16 feet, tonnage 1,340 tons. The engines are so constructed as to diminish the consumption of steam and fuel. It is said that they consume 33 tons of coal a day. The total cost of the vessel when it was launched was 55,000*l.*; since that time improvements have been effected in it which have amounted to 15,000*l.* It carries 700 tons of goods, 135 passengers. The rest represents the weight of the engine, the boilers, and the water.

sixteen days going, and from thirteen to fourteen days coming back: the last voyage was even accomplished in eleven and a half days.

During two years, since they begun their operations, with what strides have the English advanced?

A first line from Bristol to New York was established in 1838. The company to whom it belongs has four steamers of 450 horse power —namely, the Sirius, the Great Western, the Royal William, and the Liverpool. The price of each of these boats is 1,300,000f. It is said that they now are building an iron steamer, which is to carry two engines, whose united powers will amount to 1,000 horses. These engines were constructed on the plan of Mr. Humphreys; the boat will only be 100 metres in length, and will have room for 300 passengers, and a considerable quantity of merchandise. The works are in active continuation, and will be terminated, according to appearces, in the course of the year 1841.

Another line was established for the service of London and New York. Two vessels were employed on it—the British Queen and the President; the engine of the British Queen was of 500 horse power, that of the President 600; they can accommodate from 225 to 250 passengers, and receive a load of from 500 to 600 tons. A third line connects New York to Liverpool, so that there are already three establishments sending steam vessels from different parts of Great Britain to the United States.

Moreover, a compact was sealed on the 4th of July, 1839, between the Admiralty and Mr. Samuel Cunard, for the transit of letters from Liverpool to Halifax. Mr Cunard has engaged that there should be two departures per month, and receives from the Government an annual remuneration of 1,500,000f. The Britannia, of 450 horse power, was launched into the sea in the beginning of February, 1839.

Lastly, a more extensive service will soon connect Great Britain with the West India Islands; there is a company in existence under the name of the Royal Steam Navigation Company, which is preparing vessels for New Orleans, Mexico, and part of the South American coast. This company the Government indemnifies by an annual payment of 6,000,000.

You must all perceive, gentlemen, that we must not delay entering into the lists, for we are urged on by competition from every quarter, and the appearance of English steamers on every point of the New World to the exclusion of our own, would soon banish us from those regions.

However serious the character of these motives, gentlemen, they are, however, secondary when compared to the consideration which we will not endeavour to conceal. The navy is a weapon, and one which to all appearances is destined to play an important part in the conflicts which a future day may bring to light. Attempting to foretell what consequences may be reserved for a future period by the introduction of steam in constructing ships of war would be presumptuous; it is a question of entirely recent origin; experiments with regard to it are in their infancy. It is, however, already discernible that the use of new motors will infallibly produce the following effects:

—In the first place, it will render every vessel in similar conditions equally supple and tractable, by whatever men she may be manned. It will be sufficient to have able engineers in order to effect manœuvres with a facility and precision as entirely independent of the state of the sea as of the greater or less aptitude of the sailors.

Secondly, the number and proportion of the men required for the performance of the ship's duty would be entirely changed. The Great Western, whose form and dimensions are nearly those of an ordinary frigate, is conducted by fifty men, including engineers and stokers. Now, if it be true that the naval enrolment of France is incompetent to supply all its necessities, this inconvenience will vanish; and the more so, because the zone in which we shall be able to find men fit for the service will be extended.

Lastly, the draught of water occasioned by a steamer depends upon its power; but for all it is less than that of ships of war. Whence it follows, that instead of the five or six ports to which our vessels and frigates can resort, steam-boats will be able to cast anchor off any coast, and, so to speak, in any bay.

Thus the new vessels provided with a good engine will be swift, will offer less hold to the enemy, will have a greater number of safe harbours to resort to, will require a less numerous crew, and require less previous apprenticeship than in sailing vessels. This will evidently become a new weapon; and if these ships carry guns for the discharge of bombs of a recent invention, whose effect is such that at one discharge they are capable of disabling the largest craft, they will become a weapon at once easy of management, safe, and of the most destructive nature. Is there not wherewithal here to change the whole direction of naval tactics, all the proportions existing between the powers of nations? Here is an entire revolution. Slow or fast, partial or complete, this revolution will ensue. Now, with the example given us by a Government whose energetical endeavours are dedicated to the continued increase of its naval resources, when we see Great Britain during two years continually multiplying, at the cost of such enormous sacrifices, its steam navigation, and finding in the gigantic establishments of its industry those inexhaustible resources of which we are deprived, would it be wise, would it be prudent, to continue our *materiel* in its present state, to abstain from making some progress in the new career which has been traced out to us? Undoubtedly we do not indulge in the chimera that our country can ever equal the English in their naval establishment. The strength of the British nation rests entirely on its foreign trade; they are an exclusively seafaring nation. All the springs of its prosperity are there; it drags after it that colossal superiority which constituted at once its greatness and its peril. The conditions of existence in which France is situated are different; but the extent of its coast, its position, the genius of a portion of its inhabitants, compel it to possess a navy, and in that case it is becoming that, wherever she may be pleased to hoist her flag, she may be enabled to assemble and display a sufficient force in order to

insure respect. Without this she could never effectually protect her national interests beyond the seas.*

The construction of steam-boats for transatlantic voyages presents, then, a double object to our view. Applied, in time of peace, to the growth and preservation of our commerce, they may be transformed, during hostilities, into ships of war; they may assume, in turn, the double character of a defensive weapon and of a means of conveyance —of a commercial and of a military navy; to-day they may carry merchandise, and when requisite guns. Civ. Eng. & Arch. Jour.

Steam Packets to convey the Mails between France and America.

We, Louis Philippe, King of the French, have proposed, the Chambers have adopted, we have ordered and do order the following:—

Article 1. A line of steam packets shall be established in order to convey the mails between the ports of Havre and New York.

The Minister of Finance is authorized to treat, within the space of three months, with a commercial company who will undertake the service, on condition that they receive in payment an annual fee not exceeding 880f. per horse power. The number of steam packets to be employed in the service of this line shall be three at the least, or five at the most; each packet to be propelled by engines of 450 horse power.

A list of conditions, to be drawn out by the administration, will determine the times of departure, the number of passengers, and every detail relative to the service of this line.

2. Two principal lines of communication shall be established by the Government, in order to convey the mails between France and America, and served by steam packets of 450 horse power, one starting from Bordeaux every 20 days, and from Marseilles every month, in order to arrive at Martinique, and continuing by Guadaloupe, St. Thomas', Porto Rico, Cape Hayti, and St. Jago, to Havanna; the other starting from St. Nazaire every month to Rio Janeiro, passing by Lisbon, Goree, Pernambuco, and Bahia. Three secondary lines, served by steamers of 220 horse power, will be established in order to continue the principal lines, the first to Mexico, touching at Vera Cruz, Tampico, Galveston, and New Orleans; the second to Central America, touching at Chagres, Carthagena, Santa Martha, and La Guayra; the third to Montevideo and Buenos Ayres.

To effect this a special credit has been opened to the Minister of the Navy, to the amount of 28,400,000f., to be devoted to the construction, arming, and fitting up of 14 steam packets of 450 horse power, and four steam packets of 220 horse power, and which is to be appropriated to the expenditures of 1840, 1841, 1842, and 1843.

* England had, in 1831, 840 commercial steam-boats, representing altogether 64,700 horse power. Besides which, the English Admiralty possesses 66 vessels, whose powers amount to nearly 9,400 horses, while in France we reckon only 640 commercial steamers, and 38 belonging to Government.

From the total sum of 28,400,000f. a grant is made to the Minister of the Navy—

	Francs.
1. For the year 1840, of - -	5,000,000
2. For the year 1841, of - -	10,000,000
Total - - - -	15,000,000

3. The steam boats belonging to the Government shall be constructed so as to enable them, in case of necessity, to carry guns, and when performing the duty of packets to carry merchandize. Ibid.

Incrustation in Steam Engine Boilers.

We are informed by *L'Echo du Monde Savant*, of the 25th of July, that M. Edouard Richard had presented to the Geological Society of France a calcareous incrustation, which must be considered of great value, as it was not formed in the boiler, but in the cylinder of the engine, and beneath the piston. The incrustation formed a disc 12½ centimetres in thickness; and in consequence of the pressure of the piston, it is so hard that it is capable of receiving as high a polish as the densest marble. It is evident, therefore, that explosions may be produced as well by calcareous concretions of the cylinders as of the boilers of steam engines. The engine from which this specimen was procured, has been used for the purpose of pumping water from the mine of Auzin, and has been built after Newcomen's plan.—In *L'Echo du Monde Savant* of August the 5th, we find a communication upon the subject of steam boiler explosions by M. Flesselle, a retired officer of the French Marine, resident at Graville, near Havre. M. Flesselle suggests, that, in order to prevent the formation of calcareous incrustations, (which have long been considered the principal causes of accident,) some common salt or muriate of potash, should be put into the boiler with each fresh supply of water. M. Flesselle recommends this measure, because the incrustations are formed of the carbonate, the sulphate, and perhaps the phosphate of lime—(salts, insoluble, or sparingly soluble;) and these salts, boiled with the muriate of soda (common salt,) or muriate of potash, will undergo double decomposition with these muriates; the products being the carbonate, sulphate, and phosphate of soda, and the muriate of lime—salts all of which are soluble.

M. Flesselle says that M. Chaix, of Maurice, has invented a method of preventing explosions, which appears to have been adopted with success in the French government steam vessels; but M. F. considers that auxiliary means also are requisite—and we think he is right; for the fact we have related regarding the engine at Auzin, proves that we should avail ourselves of every cheap and simple aid to prevent the fearful accidents to which incrustations may give rise, seeing that the sulphate, carbonate, and phosphate of lime may be held in suspension by the steam—be carried by it in a state of minute molecular division even into the cylinders—and there also be deposited in the form of hard concretions.—The method of M. Flesselle, seeming found-

ed on correct chemical principles, will, we hope, be put to the test of experience, by some of the numerous engineers of our neighbourhood. We shall feel great pleasure in recording the result.

In England the precaution taken against incrustations is an index of the density of the fluid in the boiler; but this is evidently inadequate —for the calcareous particles are conveyed by the steam into the pipes and cylinder. Perhaps some of our scientific readers will have the goodness to inform us whether the English method of preventing incrustations is identical with that of M. Chaix.—*Gateshead Observer.*

Ibid.

On the Construction of Lime Kilns. *By* Sir C. G. Stuart Menteath, *Bart.*

Having been engaged in burning lime for the supply of an extensive district of country for agricultural improvements, and being distant from coal sixteen miles, it was desirable to find out the best constructed kiln for burning lime with the smallest quantity of coal, and having been aware from experiment that the kilns generally employed in Great Britain for burning lime are of a construction too narrow at bottom, and too wide at top, many kilns of this construction being not more than three or four feet wide at bottom, and 18 feet wide at the height of 21 feet, were found to waste the fuel during the process of calcining the lime, or in other words, did not produce more than two measures of burnt lime shells for one measure of coal; but it is to be understood, that in whatever construction of kiln lime is burnt, the fuel required to burn limestone must vary according to the softness, or hardness, or density of the stone, and the quality or strength of the coal used. The same measure of coal in Scotland called chews, when employed, will burn a greater quantity of lime in a given time than the same quantity or weight of small coal, the chews or small pieces of coal admitting the air to circulate more freely through the kiln. Though this fact should be well known to lime-burners, yet they frequently employ small coal in burning lime, from its being procured at a less price, though really at a greater expense, as it requires a much larger quantity to produce the same effect, and a longer time to admit of equal quantities of lime being drawn out of the same kiln in a given time.

For a sale of lime for agricultural purposes in a limited district, I have found kilns of small dimensions to be most profitable; the construction of a kiln I have employed for many years was of an oval shape, five feet wide at bottom, widening gradually to six feet at the height of 18 feet, and continuing at that width to 28 feet high from the bottom. A kiln of this construction has been found to burn lime in much less time, and with a smaller proportion of fuel, than kilns of large dimensions, narrow at bottom and wide at top, as heat is well known to ascend more rapidly in a perpendicular than in a sloping direction, from which arises the superiority of a narrow kiln, with sides nearly perpendicular, compared with one with sides that slope rapidly.

Those narrow kilns will admit of being drawn out of them every

day, if fully employed, more than two-thirds or nearly three-fourths of what they contain, of well burnt lime, and afford fully three of lime-shells for one measure of coal, when large circular kilns will not give out more than one half of their contents every day, and require nearly one of coal for every two measures of lime burnt. In a country sale of lime, the quantity sold every day is liable to great fluctuations; two or three cart loads will sometimes only be required from an establishment which, the day before, supplied forty; and as lime is known to be a commodity, when exposed to the action of air, which becomes more bulky and heavy, and in that state does not admit of being carried to a distance without additional labour, it has been an object of importance with me to find out a construction of a kiln which will allow of lime being kept for several days without slacking, and at the same time to prevent the fire escaping at the top of the kiln, if the kiln stand twenty-four hours without being employed, especially during the autumn and winter when the air is cold and the nights long. I now employ kilns of an egg shape, and also oval; the oval-shaped kilns are divided by arches across the kiln, descending four feet from the top; the object of the arches across the kiln is to prevent the sides of the kiln falling in or contracting, and also to enable you to form circular openings for feeding in the stone and coal at the mouth of the kiln; upon this plan, a kiln of any length might be constructed with numerous round mouths. From the great expense attending the driving of fuel from a distance of twenty-five miles from my own coal-pits, I have adopted the practice of cokeing the coal, which is a saving of two-fifths of the weight, and I find that an equal measure of coal and coke have the same quantity of heat in burning lime, which is somewhat paradoxical, but not the less true. The coal is found to have little effect upon the stone till it is deprived of its bitumen, or is coked in the kiln; for, during the time the smoke is emitted from the top of a lime kiln, little or no heat is evolved; or, in other words, does not the smoke carry off the heat, which is not given out from the smoke till it is inflamed, which does not take place in the ordinary lime kilns? A kiln in which coke is the fuel employed will yield nearly a third more lime shells in a given time than when coal is the fuel, so that coke may be used occasionally when a greater quantity of lime is required in a certain time than usual, as it is well known to lime burners that the process of burning is done most economically when the kiln is in full action, so as almost constantly to have a column of fire from the bottom to the top of the kiln, with as short intervals as possible in working the kiln.

Having found that limestone is apt to be vitrified during the process of calcination during stormy weather, from the increased circulation of air through the kiln, which adds much to the heat derived from the fuel employed, and which experienced lime-burners would have diminished could they be aware at all times of an occurrence of this kind; from having experience of the bad effects of too great a circulation without properly providing against it, I have reason to believe that by having a power to throw in at pleasure an additional quantity of air into the bottom of a lime kiln, a considerable saving of

fuel necessary for the calcination of lime would take place, and another object would be gained, that of cooling the limestone in the bottom of the kiln, which frequently retards the drawing out of the burnt limestone for some hours, or until the limestone is so cold as not to burn the wooden structure of carts.

In working a kiln with narrow circular mouths, the stone and coal should be carefully measured, so that the workmen can proportion the fuel employed to the quantity of stones, and it is obvious, that the quantity of coal to be used must depend upon its relative quality, and the hardness of the stone to be burnt. If this measure was adopted in kilns of any construction, the lime shells would be found better burnt.—[*The Dublin Advertiser.*

Civ. Eng. and Arch. Jour.

Galvanic Battery.

Much difficulty arises in naming the two poles of a battery; they are called the positive end and the negative end, the anode and the kathode, the platinode and the zincode; now as each pole of a simple battery becomes reversed if the battery is doubled, Mr. Smee proposes (*Philosophical Magazine*, for May) to name the two ends from the oxygen and hydrogen, since it has been shown that the galvanic current owes its power of decomposing many substances entirely to these gases. The names which are proposed are the *oxode*, at which oxygen is evolved, and the *hydrogode*, where the hydrogen is given off.

Mech. Mag.

On the Augmentation of the Force of Powder by the Admixture of other Bodies. By Mr. Mayer, Mining Superintendent at Gengenbach, near Offenburg, in the Dutchy of Baden.

As it may be interesting to such of your readers as are engaged in mining pursuits, to be made acquainted with the various results in different districts, of the method now known for several years of mixing powder with sawdust, in order to obtain increased effect in blasting, I hope it will not be unacceptable to them and to the mining public in general, if I present them the following details of the experiments made in this district; since, by comparing these with other trials, improvements may probably be suggested in the method of procedure:—Our first efforts were directed to ascertain the exact proportion of the sawdust to the powder, in order to obtain the maximum of expansive force; and it was found, after numerous trials, that in some of the mines of this district, where one pound of powder was formerly used to make up six cartridges, now nine cartridges are made up with the mixture. In other mines of the Grand Dutchy of Baden, and particularly in my own official district, one pound of powder used to be requisite to fill eight cartridges, but on being mixed with sawdust, one pound of powder was sufficient for twelve cartridges; and, afterwards, on our becoming more skilled in the management of the whole

process, sixteen cartridges were made from the same quantity—an increase of one-third, and subsequently of one-half in the number of cartridges—the effect being found equal to what could be expected from powder alone, and failures in the blast not being more frequent than is usually the case in all mines; of this I have been an eyewitness, in a very great number of instances.

It has been objected that the additional length of the cartridges would render it necessary to work a deeper hole in the rock, so that the increased labour required would in part counterbalance the saving of powder; but to this remark I have to reply, that the superior elasticity of the mixture admits of the six-inch cartridge being pressed down by the clay to the length of four inches only, and consequently, in a hole ten or eleven inches deep, there remains six or seven inches for the clay, which is, beyond doubt, quite sufficient; and it may be observed, that the holes are very seldom worked to a less depth than ten to eleven inches. In some places, however, the mixture has not met with the same approbation; but I am not able to state whether this be owing to a want of correctness and attention in the operations, or to a lurking prejudice against innovation.

The objections which had been brought forward against the sawdust, led me to reflect whether some other substance might not be equally efficient, and an incidental circumstance seemed to indicate the very material. Being out with a shooting party, after firing my piece several times, I found myself at a loss for wadding, and, in the hurry of the moment, made use of some envelopes of letters, on which there was a more than ordinary quantity of sealing-wax. I had scarcely pulled the trigger, when I experienced a gratification not generally calculated upon by sportsmen—that of being, in no very gentle manner, extended on the turf—and the pain I felt in the shoulder and head, might have made me wish I had postponed the shot till my next excursion, if I had not thought I had made the very discovery of which I was in search, since I naturally attributed the force of the charge to the sealing-wax. On my return home I made some trials, not with the usual component parts of sealing-wax, but with the colophorium (resin) alone. For a bore requiring two ounces of pure powder, I took one and a half ounce, adding the eighth-part of an ounce of powdered resin, which was combined with the powder by friction on a sheet of smooth paper, the mixture being indicated as accomplished, when the black colour of the powder assumed a yellowish hue from the resin. Being filled into a cartridge for a hole sixteen inches deep and one inch in diameter, bored in a granite block of great hardness, and two and a half feet long, two feet wide, and two and a half feet high, the cartridge occupied three inches, and the remainder was rammed with heavy spar. The explosion was perfect, and the mass burst into four nearly equal pieces, besides several small ones—one of the former being thrown a distance of four paces. Concluding from this excess of force, and from the well grounded report, that less powder would do, I tried, in a similar hole, one ounce of powder to one-sixteenth of an ounce of resin, and I was pleased to find the effect fully equal to what might be expected from two ounces of powder alone.

After these experiments, I found it easy to account for the violent recoil and loud report of my fowling-piece—the resin having produced a more immediate and rapid ignition of the whole mass. It is to be observed, that on using unmixed powder, many of the grains are lost, as is evident from the black streaks discernible after shooting over snow with the gun muzzle near the ground—the piece being held horizontally. These marks or streaks of powder must generally consist of one-half of the charge, but similar appearances are not visible on using the mixture. I was now so fully convinced that this last mixture would effect a saving of one-half of the powder, that I immediately introduced the use of it in these mines, where it has ever since, namely, a year, been used with the same uniform result, and has even been adopted in a colliery, where the managers had previously tried the sawdust without success.

On using this mixture of colophorium, there never occur those so called (Bichsen,) but the whole rock round the hole is sprung from the powder-bag; and, moreover, it is observed, that the blast takes effect in almost every case below or behind the bore in the rock itself.

With regard to the expense of the commonest resin, which is what I use, the value of one ounce of it to one pound of powder is very little; and even the finest resin, at two kreutzers the ounce (about three farthings,) saves a pound of powder, which usually costs from twenty-four to thirty kreutzers (from 8d. to 10d.)

I next made trials with the *semen lycopodii,* which possesses in a high degree the qualities requisite for the immediate combustion of the powder, and found it to produce the same effects as the mixture with sawdust or with resin; but as a pound of this seed will suffice to mix with powder for 512 blasts, I consider that its application may be advisable when it can be procured in sufficient quantities.

Mining Review.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

The Paris Fair of 1839.

The exposition of the objects of French National Industry at Paris, in 1839, was a brilliant affair. A building was erected under the direction of M. Moreau, the government architect, in the great square of the Champs-Elysées, six hundred feet long, and two hundred and seventy wide, fronting on the grand Avenue. The façade exhibited five openings, the central one being decorated by a saillant peristyle, and the continuous acroter which crowned the façade was divided into compartments, on which were inscriptions in bas-relief which announced to visitors the divisions and classifications of the objects of the interior.

The bas-reliefs, ingeniously devised by the architect, exhibited the different branches of industry, being represented by children or little genii, performing the manual and theoretical operations which

brought forth those rich productions (plates representing these designs are given in the *Recueil de la Societié Polytechnique*, for May, 1839.) We have thought it would not be uninteresting to our readers to be in possession of the substance of the address to the king, and his reply on the occasion of this splendid exposition. G.

Discourse addressed to the King, by Baron Thenard, President of the Central Jury.

Sire,—It was a happy thought which conceived the plan of exhibiting specimens of all the most remarkable fruits of the industry of a great population, and of perpetuating the remembrance of it by rewards imposingly distributed by the head of the nation.

This idea is the more worthy of France, inasmuch as it was first accomplished when she was combatting with all the powers of Europe, leagued against her independence.

More than forty years have since elapsed; the plan has of course been subjected to the ordeal of time, and the still more trying ordeal of political revolutions.

The consulate received it from the directory to attach it to the empire, which, in turn, transmitted it to the restoration. The government of July adopted it as a National Institution.

Its early operations could not fail to be injured by the calamities which war always brings in its train; but peace was no sooner re-established and consolidated, than industry, which had been, as it were, enchained, sprang forth afresh, kindled under the light of experience, and penetrated into regions where it was before unknown. The fairs of 1819 to 1827, revealed to England the truth that she would soon have a rival in the arts. These high hopes were justified by the exhibition of 1834, and are realized by that of 1839.

Yes, sire, a grand progress has been made within the last few years.

Wool spinning by machinery we have completely acquired; that of flax will not be long in arrears. These are arts which will form important additions to the balance sheet of our commerce.

More than fifty factories have constructed steam engines of common force; let the state assist them and soon will they furnish those powerful motors which our marine and our industry are now demanding. Steam factories were scarcely in existence in France at the beginning of the present century; now they are counted by thousands; our manufacturing villages will in time be covered with them.

Paper machines for continuous sheets have been carried to so high a degree of perfection that they are exported to foreign countries.

The Jacquard loom, so eminently useful, has received new improvements.

An ingenious mechanism fashions wood into furniture, ornaments, gun stocks, &c., with great rapidity and precision.

Excellent tried chronometers cost one half less than in 1834; all our ships will be provided with them, and will be no longer in danger of a fatal coast in stormy weather.

From England came all the needles requisite for our use,—France now produces them in the most desirable perfection.

New products have sprung up in our factories; the starine candle, so unexpectedly pleasant; the dye of prussian blue, which in time will supersede entirely the use of indigo.

Our flint glass is as limpid and of as perfect a cut as foreign glass—it is sought for from abroad on account of the elegance of its forms, the variety of its colours, and the solidity of its metallic decorations.

Nothing more beautiful and splendid than our window glass;—it surpasses that of the ancients, so justly extolled.

The manufacture of flint and crown glass by a systematic process, which would furnish them of perfect quality and convenient dimensions for all optical purposes, has been long an object of anxious search; this important problem is now solved.

A great advance has been made in the mode of decorating porcelain and increasing its value.

Lithograpic stones, of superior quality, have been discovered in several parts of the kingdom; and the rarest works can now be reproduced by lithography, with all the characters which distinguish them.

The beautiful marble of our Pyrenees, scarcely known fifteen years ago, now not only suffices for our own wants, but has become an article of considerable export.

Iron is preserved from rust by means very simple and apparently efficacious.

Laminated bronze lines our vessels, and insures them a duration greater than those of copper.

Nitre, by an improved process, is manufactured in competition with that of India.

Our calicoes, silks, and shawls are constantly displayed in the shops of London, and our muslins, plain and embroidered, seem driven from our markets to those of England and Switzerland.

In the management of silkworms great progress has been made; a great number of mulberries have been planted; and there is every reason to believe that in ten years France will be relieved from the tribute which she is paying to foreign countries, the amount of which is not less than 40,000,000 francs annually.

Starch is transformed, at the will of the manufacturer, either into a low priced sugar, which serves for the improvement of wine and beer, or into dextrine, which takes the place of gum senegal in calico printing, colouring, and dressing cloth. The fabrication of these articles amounts to 6,000,000 kilogrammes (= 14 mill. lbs.)

Eight years have scarcely elapsed since England furnished us with all the varnished leather which our consumption required. At present England is obtaining it from France. In the art of tanning great progress has been made. Our moroccos obtain the preference in every market.

All the branches of industry have improved; in almost all the prices have fallen.

(The President proceeds to descant upon the vast accessions of the arts and to human skill and power which have been witnessed within the last forty years,—claims for France and Papin the *invention* of the steam engine, but ascribes to Watt its *perfection* and applications.

He brings into view as the causes which have produced these wonderful results:—)

Peace, which is the soul of industry; Science, which sheds a most vivid light upon the arts, and preserves them from the errors of a blind and deceptive routine of action; learned societies, and especially *la sociétié d'encouragement* which, by its numerous and energetic assemblings, have resolved the most important and difficult questions.

(Another cause to which much of these effects is assigned is the public exhibitions, bringing together vast numbers of all classes to witness the progress of art, and the beauty of its productions, tending to aggrandize the French name, and to make the people proud of their country. In a few years they will have nothing to envy from England.)

Yourself, Sire, and by your example the Prince Royal, have been happily convinced, while, surrounded by your august family, you have spent whole days in visiting the exhibition with so lively an interest. Every fresh visit has been a source of increased pleasure. It has induced you to address congratulations to the manufacturers with whom you have been pleased to converse, and your praises have been the more touching from the paternal kindness which have accompanied those evidences of discernment which an intimate knowledge of the arts could alone confer.

In fact, when we consider what was the state of things at the termination of the empire, and what it is now, who can tell where the progression will stop if its rapid march is not suspended by WAR? Its destinies will be immense. Enlightened by science, it will imprint its character and genius on the age, and there will hereafter be ages of industry as there has been ages of warriors, and ages of literature and painting.

Sire, you have been able to preserve peace in the midst of a revolution which might have produced a general conflagration. Your exalted wisdom will be able to sustain it; this will be your work and your glory. A new era, a pacific era, will take its date from the foundation of your dynasty. Instead of destroying, you will build up. Already have you saved from certain ruin the palace of a great king, by founding upon it this monument, this historic museum, which alone is sufficient to render one reign illustrious. You will cause letters, science, and all the arts to flourish; you will vivify agriculture; you will cause commerce to reach the most distant countries; you will every where spread the blessing of civilization.

History will not inscribe your name among conquerors, but posterity, just in its decision, will place you, sire, in the list of kings who have been the fathers of their people,—of crown princes, rare indeed, who devote their lives to the salvation of their country, and who use their power only to give a more useful direction to the true sources of public prosperity.

The King's Reply.

To perform this task is the first of my duties;—to learn from you that I am advancing towards its accomplishment is the sweetest re-

ward that I can receive from my labours, and my efforts to secure the happiness, the greatness, and the prosperity of France. Gentlemen, I was impatient to be in the midst of you, to thank you in the name of my family and for myself, for all the sensations you have inspired me with, whenever I have visited this magnificent exposition which you have just given to France;—to tell you how intimately I feel myself associated with your labours, and how pleased I am in believing that their constantly increasing results will justify the high hopes which your worthy President has just presented to my view. I agree with him that it is to the epoch of that terrible crisis in which so many sacrifices were made by the nation,—in which every French heart sprang from its fireside to the defence of its country,—abandoning its profession, its family, its dearest interests, to preserve France from foreign invasion,—that was commenced the long series of expositions of its genius which years have just crowned in so brilliant and splendid a manner. In the very deficiency of those early efforts, might be seen an expression of the wish of France to urge its government and those who then presided over its destinies, to put an end to the scourge of war as soon as the honour of the country should be satisfied, and its independence secured. In fact, the vow of France and its first necessity was to enter into a state of peace, the only means of regaining all the safety and repose necessary to the free indulgence of its genius and the full development of its best faculties. In was, in some sort, a salutary warning that the time had arrived when the resources of France should be applied to its real wants, and no longer absorbed in the pursuits of chimerical conquests, in the subjugation of its neighbouring people, and in the extension of a domination in which we have no interest nor any desire of persevering. But these times of trial are already remote; the national wish has prevailed. Internally tranquil, we are at peace with all our neighbours, and nothing need disturb you or constrain you in pursuing after those combinations in which you are so happily engaged. It is by a judicious employment of all our resources, that private fortunes must continue to increase and ease and comfort spread from family to family. You have already succeeded in furnishing the poorest and most necessitous classes with the low priced stuffs which clothe them, in satisfying their wants, and in procuring for them comforts until now unknown, by the reduction of prices to the means within their reach. For these blessings you deserve their thanks. It is thus that you really become their protectors and true friends of humanity;—you contribute by your labours and success to the improvement of the condition of all classes of society and are in the way of accomplishing the wishes that are dearest to my heart.

Continue in this noble career with perseverance. The exposition exhibits productions which demonstrate that you are in the good way, that is to say, that you prefer the solid and the useful to the brilliant and the tinsel, which merely seduces. By thus infusing good faith into the composition of your products you inspire that confidence which can alone give prosperity to commerce and turn the people from that deplorable mania for hoarding up, which, by absorbing a portion of

the resources of society, paralyses the means of augmenting the national wealth and of course the public prosperity. They must have confidence in your good faith and in the moderation of your prices. The nature of your products must be such that their uses may calm distrust, and convince the purchasers that they have not been deceived. The people must learn that there is no occasion for them to hoard up and to bury their riches in the earth, in order to place them in security. The actual state of civilization ought to convince them that such fears can only exist among a demi-barbarous population who know no law but force, and whose chiefs think only of appropriating to themselves the wealth and the property of their subjects.

For ourselves, we have, thank God, another mission to fulfil. It is ours to protect the rights of all, to cause the property of all to be respected, to prevent any one from touching it without the consent of the owner. The imposts regularly voted by the nation are employed in its interests, and devoted to the public wants under the supervision of its own appointed authorities. Now that we are free from any of the grand necessities of war, our public credit has risen to an extent unprecedented, and nothing restrains us in the application of our immense resources to every thing which may increase the national wealth and confirm the happiness and prosperity of France.

The statements, which have just been made by your President, which were heard with so much pleasure, are a further proof of the confidence which we ought to place in the future; it will not be stationary.

Our progress, however great it may be, will not rest where it is. To what extent will it go? I know not, and think that no one can foresee or calculate the flight which the national genius imprints upon the conquests of industry and public wealth,—those conquests by which none are despoiled, no personal rights violated, and no tears caused to be shed. This is what we desire,—this is what we are pursuing. We shall continue to respect the independence of our neighbours, as they will respect ours. The victories which France has so often attached to its flag are pledges, as certain as they are glorious, of our repose and our safety. It is by persisting in this salutary path that we shall behold our commerce and industry increasing by the stability which peace affords, and the confidence which foreign nations will place in our productions, when we furnish them frankly and loyally always satisfying ourselves with a moderate profit. They may see in our expositions the manner in which French manufacturers direct their labour. To them they will furnish an example;—to us a pleasure. I was anxious to be once more amongst you, to repeat to you how sensible I am to the testimonies of affection which I have received in the numerous visits I have made to the exposition. I regret that it is over, since I shall be deprived of the opportunities of meeting with you, of hearing you, and discoursing with you.

Recueil Soc Polytech.

Means of Preserving Cordage, Cloth, and Nets.

Fishermen on the English coast use the following method:

For one pound of thread take tan of good quality, two pounds. Boil in a suitable quantity of water six hours.

Let the tan boil alone during the first hour in a moderate quantity of water, and then put in the stuff, adding more water and keeping up the ebullition by a great heat. The stuff should not touch the sides of the kettle.

Articles thus tanned will last many years, especially if steeped once a year when they are much used. Ibid.

To determine whether Flannel contains Cotton.

Take a given weight of the flannel, 10, 20, or 30 parts, and boil it in strong ley, or solution of potash, the flannel soon dissolves and is converted into soap, while the cotton is but slightly altered. The insoluble residue (the cotton) is washed, dried and weighed, and thus its proportion of the tissue is ascertained. Ibid.

Progress of Physical Science.

*Abstract of the Proceedings of the Physical Section of the British Association for the Advancement of Science.**

"On a Blue Sun seen at Bermuda."

On the 11th of August, 1831, this curious phenomenon was observed. Not only the sun appeared of a blue colour, but white objects, such as the sails of vessels, were similarly tinged, and the sea appeared of a dingy yellow. On the day when these observations were made at and near Bermuda, a hurricane was passing over St. Vincent. Sir David Brewster, to whom these observations were communicated by Lieut. Col. Reid, Governor of Bermuda, attributes the colour to the interposition of vapour or of vesicles of water, between the eye of the observer and the sun, and remarks that the same cause may produce other colours; he had, for instance, once observed the sun to be of a salmon colour,† in which both yellow and red were mixed with blue. The phenomenon is analagous to that of the colours in sulphate of lime and other minerals containing strata of minute cavities filled with fluids; the colours resulting from diffraction at the edges of the transparent bodies, separating media of different densities.

Results of Hourly Meteorological Observations.

These observations were made at Inverness and Kingussie, under the direction of Sir David Brewster, by competent observers, and

* From the report of the proceedings given in the London Athenæum, for Oct., 1840.

† Early in August, 1831, though I cannot now fix the date, the sun was seen of this colour for some days in succession along the Atlantic Coast. [A. D. B.]

with standard instruments. In reporting upon them, Sir David Brewster remarks, that "when these observations are compared with those made at Leith, under my superintendence for four years, with those made at Plymouth from 1832 to 1840, at the expense of the Association, and under the able superintendence of Mr. Snow Harris, and with those made at Padua, Philadelphia,* and in Ceylon, we perceive very distinct traces of meteorological laws, of which no idea had been previously formed; and I have no hesitation in stating that when this class of observations are multiplied and extended, they will lead to general results of as great importance in predetermining atmospherical changes, as those which have enabled the astronomer to predict the phenomena of the planetary system."

The mean value of the interval between the times of the morning and evening temperatures which correspond to the mean of the day, deduced from the average of nine stations, is eleven hours and five minutes.

The curious result is derived from these meteorological observations that the periods of calm and of minima of temperature correspond to each other, and that the force of the wind depends on the average elevation of temperature.

Force of the Wind.

Mr. Osler, of Birmingham, communicated the results of observations on the force of the wind recorded by his anemometer,† during the years 1837, 8, and 9. It appears from the average of more than one thousand observations made for each hour of the day, that if a curve be traced to represent the mean of the force of the wind for each hour, it will be almost exactly the reverse of the curve of mean temperature for the day, not only for the whole year, but for each season.

Hourly Meteorological Observations in India.

Mr. Caldicott gave an account of the observatory erected at Trevandrum, by the Rajah of Trevancore, one of the native Indian Princes, and of the instruments already placed, and of those which he had been already authorized to place there. The hourly meteorological observations have been made since June, 1837.

The registers of the barometer give the times of maxima of daily pressure between the hours of 9 and 10, A. M. and P. M., and of minima between 3 and 4, P. M. and A. M.

Fall of the barometer	between	10 A. M. and 4 P. M.	0.109	inch.
Rise "	"	4 P. M. and 10 A. M.	0.108	"
Fall "	"	10 A. M. and 4 A. M.	0.071	"
Rise "	"	4 A. M. and 10 A. M.	0.073	"

* At Frankford Arsenal, under the direction of Captain Mordecai. See this journal, vol. xix. p. 7.—[A. D. B.]

† One of these admirable instruments has been mounted, under my charge, in the Philadelphia Magnetic Observatory, and its registers preserved since June, 1840. [A. D. B.]

Tides in the German Ocean.

The curious feature shown by the Rev. Prof. WHEWELL, in his map of co-tidal lines, in regard to the tides of the southern parts of the German ocean, is stated by him to have been recently confirmed by observation. He had found that the tide wave there, must have a rotary motion, traveling southwards along the coast of Norfolk and Suffolk, England, then crossing over to the coast of Holland, and traveling along that coast from south to north. Hence it follows that at a certain point of the sea between England and Holland there is *no tide*, the surface neither rising nor falling. Capt. HEWITT, in his recent survey of the German ocean, has found a place where the rise and fall in the twenty-four hours is so small that it may be considered as not existing.

Photogenic Drawing.

Professor SCHÄFTHAEUTL, of Munich, described his mode of obtaining photogenic drawings resembling those of Mr. TALBOT, where the lights are represented by shadows, and also two new methods of procuring drawings similar to those of the Daguerreotype, in which the lights and shades are represented as in nature. The first is on paper, prepared as follows. A concentrated solution of nitrate of silver is made by dissolving 140 grs. to 2½ drachms of fused nitrate in 6 fluid drachms of distilled water, and placed in a large dish, and the paper drawn over the surface of the solution. The nitrate taken up by the paper is converted into chloride by exposure to the vapour of boiling muriatic acid. This chloride has a peculiar silky lustre. The sensibility of the paper is increased to the highest point possible by again drawing it over the surface of the solution of the nitrate of silver and then drying. To fix the drawing obtained upon this paper, it is steeped for five or ten minutes in alcohol, the superfluous moisture removed by blotting paper, and then slightly dried before the fire. It is next drawn through diluted muriatic acid, to which a few drops of acid nitrate of mercury have been added; well washed in water, and dried at a temperature of about 158° Fah. The addition of the nitrate of mercury requires great caution, because if added in too great quantities the lightest shades disappear entirely; hence the proper action of the solution should be ascertained by trial upon small slips of prepared paper, which have been exposed to light.

To obtain the second kind of drawings above referred to, Dr. Schafthaeutl employs one or other of the following means. The paper which has just been described is allowed to darken in a bright sun light, and is then steeped for at least half an hour in a solution made by adding one part of the solution of the acid nitrate of mercury to nine or ten of alcohol. A bright lemon-coloured precipitate is thrown down, and the clear liquid is preserved for use. The paper which has been thus steeped is removed from the alcoholic solution and quickly drawn over the surface of dilute muriatic acid, prepared

by adding one part of strong acid to seven or ten of water, then quickly washed in water, and slightly and carefully dried in a temperature not exceeding 212° Fah. The paper is now prepared for bleaching by light, and the drawing may be fixed by steeping in alcohol which removes the free bi-chloride of mercury. This last maceration must not be continued too long, as in that case the paper begins to darken again.

On the decomposition of Glass.

Sir David Brewster finds by the application of refined optical experiments, that glass is subject to two kinds of decomposition. In the first the decomposition commences in joints and extends itself either in planes so as to form thin films, or in concentric coats so as to form concentric films. When the centres of decomposition are near each other, the concentric films, or strata which they form, interfere with each other, or rather unite, and the effect of this is that the glass is decomposed in films of considerable irregularity, their surfaces having a finely mamillated appearance, convex on one side and concave on the other. These films afford, by transmitted light, colours of infinite beauty and variety, surpassing any thing produced by art. They separate the compound solar spectrum, sifting, as it were, the mixed colours, as is done by coloured and absorbing media. In the other kind of decomposition the silicious and metallic components of the glass are separated, the particles of silex arranging themselves around the centres of decomposition, in alternating spheres with the metallic particles.

Preservation of Glass.

M. Lamont, director of the Observatory of Munich, states that the surface of glass lenses and prisms may be effectually preserved from the spots resulting from superficial decomposition to which it appears that Fraunhofer's glass is particularly subject, by rubbing the surface frequently with the finer parts of whiteing prepared by working a mass of whiteing in water, the fine powder thus obtained being used on old and soft linen.

Quantity of Rain at different Heights.

Professor Phillips found in a series of experiments continued from June 1st to September 3d, inclusive, that the quantity of rain collected at heights above the ground, increased by three feet at a time up to twelve feet, diminished on the average with the increase of height.

New Rain Gauges.

Professor Phillips has invented a gauge for measuring the direction from which a rain comes and the inclination of the drops. It con-

sists of five equal receiving funnels and tubes; one with a vertical tube and horizontal aperture, the other four tubes secured so as to present the funnels in four vertical planes, directed to four different quarters of the horizon. The quantities collected in the different gauges being compared, show the direction as well as the inclination of the rain.

Doctor Robinson, of Armagh, has made use of a ball to receive rain, which then descends along a capillary stem connected with the ball to a reservoir.

Remarkable Falls of Rain.

Professor Forbes gives the authority for his statement, that thirty-two inches of rain had fallen within twenty four hours at Genoa, a result which had been doubted. He also refers to a fall of twenty-nine inches and three lines (French) in twenty-two hours at Joyeuse, in France, of fourteen and a half inches in eighteen hours at Viviers, of six inches in three hours at Geneva, of four-fifths of an inch in half an hour at Perth, and of nine-tenths of an inch of hail and rain in twenty-seven minutes at Naples.*

Storm of January 6th, 1839.

Mr. Espy presented the chart of a storm which occurred in Great Britain at this period, to illustrate his position, that in all storms the wind blows inward towards the central parts, towards a point if the storm be round, and towards a line (the longest diameter,) if the storm be oblong. On the occasion above referred to, it appears that during the night, while a violent gale was blowing from the N. W. in the north western parts of the Island of Great Britain, the wind in the south-western parts was from the S.W., in the south eastern from the S.E. and S.S.E., and in the middle changed almost at the same time from the S.E. to the S.W., the change taking place about two hours sooner on the western than on the eastern side of the Island, in the central parts, and much sooner in the northern than in the southern, the storm traveling to the S. of E.†

Professor Ehrenberg's Microscopical Discoveries.

The want of numerous and varied forms of silicious infusory animals in the chalk previously noticed by the author, has now disappeared, and, in its place, great abundance has presented itself.

In all, the author has observed seventy-one different microscopic calcareous and silicious species of animals in the chalk; but, besides these,

* Mr. Benjamin Dwight records that at Catskill, New York, on the 26th of July, 1819, fifteen inches of rain fell between half past five and eleven P. M. The violence of the rain was over at nine o'clock.—[A. D. B.]

† For the papers giving an account of Mr. Espy's theory which he proceeded to develope, see this Journal vols. xvii, xviii, xix. [A. D. B.]

also numerous larger calcareous animals (1-24th of a line in size) and many included plants, Tethyæ, Sponges, Confervæ, and Fuci. The varied forms of the genera *Rotalia*, and *Textularia* of the Polythalamiæ, appear to him to constitute the great mass of the chalk of all localities. He reckons altogether seven genera and twenty-two species of polythalamic microscopic calcareous animals; and, moreover, microscopic and larger nummulites, cypridæ, &c. Further, he has hitherto determined forty species of siliceous infusory animals which belong to fourteen genera, without including the eight forms previously enumerated, and which were probably soft, and merely included in flint. He has found five species of plants containing silica. In the flints of the Jura limestone of Cracow, he detected well preserved peculiar Polythalamiæ, and remains of Sponges or Tethyæ; and lately, he has found Polythalamiæ of the chalk in the flints occurring in the gault which lies under the chalk at Cambridge in England.

A general table of these relations of the animals from the chalk and chalk-marl of the fourteen localities observed by him, and also specimens of the rocks, together with a collection of well-preserved microscopic preparations, containing nearly a perfect series of the different species of animalcules, were exhibited to the Royal Prussian Academy.

To this paper Professor Ehrenberg added a preliminary summary of his examination of the Spiral-corals or Polythalamiæ, considere d in a zoological point of view. Edinburgh Philos. Jour.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE. BY J. GRISCOM.

Account of a Whirlwind, accompanied by immense Electrical discharges, in the commune of Chatenay. By M. Peltier.

M. Peltier gave an account of a whirlwind (trombe,) which devastated the commune of Chatenay (Seine-et-Oise,) on the 18th of June last, the cause of its formation, its origin, its progress, deviations, effects and termination. After mentioning the persons who accompanied him in the examination of the region of the storm, and of the numerous persons who had witnessed it, he says:

Early in the morning a storm had gathered to the south of Chatenay, and by ten o'clock had advanced into the valley between the hills of Econen and the mount of Chatenay. The clouds were pretty high, and having extended over the village, they stopped, and the storm appeared likely to spend itself in the plain at the west, covering Chatenay only by its eastern extremity. The thunder rolled, and this first gust followed the commune track, when about noon a second gust arose also in the south, and rapidly advanced up the same plain. When it reached the extremity of the plain over Fontenay and had attained a position near the first gust which towered above the second by its greater elevation, it was arrested, and the spectators were left in doubt with respect to the direction it would be obliged to take. The thunder was heard from this second storm, when suddenly one of its lower clouds descended to the earth, and all explosion appeared to cease. A prodigious attraction now took place. All the light

bodies on the surface of the ground flew up with the dust to the point of the cloud; a continual rolling sound was heard, little clouds fluttered and whirled round the inverted cone, ascending and descending rapidly. One observer, favourably situated, saw the cone ending below in a cap of fire, while another who was on the very spot enveloped in the whirlwind of dust saw nothing of the fire. The trees situated on the south-east of the whirlwind were attacked by it on their north west side which faced it; the other half or side was preserved from its violence. The exposed side of each tree was much blasted, while the other portion retained their sap and vegetation. The whirl descended the valley to the extremity of Fontenay, and tearing up and destroying some trees which grew on the borders of a brook, which, though without water, was still moist, it crossed the valley and destroyed another plantation of trees. Here it stopped a few minutes (one person said ten minutes) as if uncertain which way to proceed, having attained a position beneath the first thunder clouds, which, though till then stationary, began to move, being repelled by the whirlwind, retrograded down the valley to the west of Chatenay. The storm closed, arrested as we have said, over the plains of Thibaust, after drying up, destroying and devastating this whole plain, advanced to the park of the Castle of Chatenay, overturning every thing on its way. Here on the mount it filled with desolation one of the most delightful habitations in the vicinity of Paris. The park lost all its finest trees. The newest plantations just beyond the verge of the storm, are all that remain; the walls were thrown down, the castle and the farm house lost their roofs and chimneys, trees were transported to the distance of several hundred yards, while rafters, staffs, tiles, &c., were carried more than five hundred. Passing from the mount, the tempest stopped over a pond, tore up and destroyed one-half of the trees, killed all the fish, moved slowly along an avenue of willows, whose roots extended into the moist ground; losing, in this place, much of its extent and violence, it advanced still more slowly along the plain, and at a thousand yards from Chatenay, near a grove of trees, it divided into two parts, the one rising into the upper regions of air, and the other becoming extinct near the surface.

In this too rapid statement, continues M. Peltier, I have designedly omitted to speak of the condition of the trees. All those which were struck by the storm presented the same appearances. Their sap was all evaporated, the ligneous fibres had lost their cohesion, and were dried up, as if they had been exposed for forty-eight hours in an oven to a heat of 300° Fah. Not a vestige of moisture remained. This immense quantity of vapour, instantly disengaged, could be liberated only by breaking the trees to pieces, and exposing all their vessels, and as the ligneous fibrils were less coherent in this longitudinal and then horizontal direction, the trees were all split into lath throughout a portion of their trunks. Fifteen hundred feet attested that they had served as conductors to masses of electricity, to continual and incessant strokes of lightning, and that such an elevation of temperature was produced by this continuous electric current as to vaporise almost instantly the whole of the moisture of these vegetable conductors.

This immediate vaporisation caused the wood to split longitudinally, and the trees, when dried, split and converted into bad conductors, were by the agitation which accompanied the storm, broken to pieces instead of being torn up by the roots.

In tracing the progress of this phenomenon, we witness the transformation of a common storm into a whirlwind. We perceive two storms near each other, the one above motionless, the other below presenting itself by clouds charged with the same electricity, the first storm repelling the other toward the ground, the clouds at the head of the second lowering and communicating with the ground by whirlwinds of dust and by trees. Thus connected, the noise of the thunder immediately ceases, the discharges occurring through the descending clouds and the trees of the plain. The latter becoming the channels of the electric current, are so heated that their sap is instantly reduced to vapour, and the trees are lacerated by the tension. Flame balls, and sparks of fire, accompanied the meteor. The odour of sulphur was perceived on some of the houses for several days, and curtains even changed in colour. Every thing tends to prove that the whirlwind was only a cloudy conductor; serving as a passage for the continuous discharges of the upper clouds; and that there is no other difference between a common thunder gust and a gust accompanied by a whirlwind, than this additional conductor which conveys the whole action of the storm to the point between the whirlwind and the ground beneath.

L'Institut p. 290.

Account of a Storm near Brussels, on the 4th of June, 1839. *By* M. Quetelet.

A storm occurred on the 4th of June, 1839, in the vicinity of Brussels, in which, according to M. Quetelet, so much rain fell as to produce an inundation, which caused the death of thirty-nine persons. It is thought the devastation must have been occasioned by a water spout.

The quantity of rain collected at the observatory at Brussels, on that day, was 112.78 millemitres, (4½ inches) which is one sixth of the quantity which fell annually at that place. So great a quantity of rain was never known before to fall at once. The most copious rain before recorded, in twenty-four hours, was on the 7th of July, 1833, the quantity being 50.27 millemitres. This last storm lasted but three hours. The barometer stood at 747.40 min. = 29.43 inches.

M. Quetelet describes a halo which appeared on the 2nd of June, at Brussels, accompanied by parhelia. It continued from half-past eleven until evening. Its colour was of a deep greyish blue, and the radius measured, about six o'clock, 22° 27′. M. Willaert, Professor at Alost, saw the primitive halo separate into two parts, the interior one being very well formed, the exterior very faint. The radius of the small circle was 22° to 20°, and that of the larger about double.

At the same time, two parhelias were formed on the circumference of the interior circle. One of the sun's images was on the southern extremity, and the other on the northern of the diameter, which passed

through the sun. The southern image emitted groups of luminous rays, which, at intervals, had the appearance of a luminous cross.

Ibid p. 286.

Rupture of a Chain by Lightning.

The Hotel of the Invalides at Paris, was struck by lightning, and according to M. Bugnot, the inspector of the buildings, a chain which had served as a portion, at least, of the conductor, in consequence of having been wound round an iron support, in order that its weight might not bear too hard on the sustaining point, was broken by the lightning, and the fluid passing off on a tangent, struck the building so violently as to throw off enormous stones to the distance of eighteen or twenty yards. This fact indicates the propriety of avoiding, in all lightning rods, turns or inflexions of too sharp an angle. Similar facts, it appears, are mentioned by some ancient authors. Ibid.

Progress of Civil Engineering.

Notes on Artesian Wells and Well Boring in France.

FROM FRENCH PUBLICATIONS.

M. Champoiseau has communicated to "the Academy of Sciences," the result of the experiments which he made at Tours, to ascertain the relation which existed between the water of his artesian well, and that of the neighbouring rivers. These experiments were continued for more than three months (March, April and May), and did not show any variation in the produce at any time, whatever were the variations in the rivers round Tours, or in the tides; neither was the limpidity of the water at all affected. Indeed the apparatus did not exhibit any sensible change in the well water, and the conclusion drawn is that the artesian wells of Tours, from the great elevation of their feeding springs, are not exposed to the irregularities observed elsewhere.

A singular circumstance recently occurred during the construction of the Left Bank Versailles Railway, near Val de Fleury, varying in its operation, and its treatment, from some similar instances, which occurred on the London and Birmingham, and other railways here. A large embankment was in progress to join the viaduct then building, but the deposit of earth had scarcely begun when an extraordinary motion was communicated to the adjoining soil. In two places it was lifted up eight or ten yards above the surface, the road was blocked up, and several houses on the disturbed site were upset. It was found that this operation proceeded from a stratum of clay, mixed with sand, and soaked with last year's rains, so as to become fluid; that the weight of the embankment, thirty yards high, and that of the superincumbent strata had put this pulpy mass in motion, and that it had disturbed the adjoining soil on the slope of the valley, and had in several places lifted up and broken through the upper strata. The

cause was apparent that water did the mischief, and though it might not have shown itself immediately if the season had been dry, yet ultimately it would have been productive of serious evil. To remedy this, there were no other means than to stop the flow of water arriving from the upper levels;-to carry which into effect it was necessary to cut the clay stratum and replace by stone work, which would surround the site on which the embankment was to be formed, and divert the water. This operation was found exceedingly difficult, having to be carried on at a depth of from six to twenty yards in a moving soil, saturated with water; it was long, very dangerous, and an accident might have wasted much valuable time, the works of the embankment being suspended in the meanwhile, and the stone-work itself being liable to be swallowed up in a few years, and the work to be done over again.

Under these circumstances, the engineers thought it advisable to have recourse to boring for the purpose of absorbing the water, and applied to the General Well-boring Company at Paris. This mode was also difficult, as the boring tube got plugged up in the soft stratum as fast as it was emptied, but by means of good tools this was at last got over. The first boring reached twenty yards, and got into the upper part of the chalk, notoriously full of fissures, and where the water was rapidly absorbed. The second and third borings were carried to thirty-five and forty yards in order to get at the chalky fissures which communicate with the Seine, and feed the neighbouring wells. A series of borings will therefore be carried round the embankment at proper distances and drains if necessary made to carry the water into the borings, which can easily be kept clear by means of a valve and cord. It is proposed also to apply this method to get rid of the water in sand, but this necessarily depends on the strata, for we believe that in the Kilsby tunnel it would not have been practicable.

Civ. Eng. and Arch. Jour.

Improved Railway Wheels.

Mr. Dircks, of Liverpool, gave an account of his improved railway wheel. The wheel may be made either of wrought or cast iron—that exhibited in the model room is of cast iron, and is one of the set of four wheels, which have run daily on a railroad for the last two months, carrying an average load of five tons, and are considered, by competent judges, to be better, if any thing, now than the first day they were put on the road. The construction of the wheel will be understood by imagining an ordinary spoked wheel, but with a deep *channeled* tyre. In this channel is inserted blocks of African oak, measuring about four by three and a half inches—prepared by filling the pores with unctuous preparations, to render it impervious to wet or dampness, by thus counteracting the effects of capillary attraction. The blocks are cut so as to fit very exactly with the grain placed vertically throughout, forming a kind of wooden tyre. There are about thirty blocks of wood round each wheel, where they are retained in their

place by bolts—the two sides of the channel having corresponding holes drilled through them for this purpose—each block of wood is thus fastened by one or two bolts, which are afterwards well rivetted. After being so fitted, the wheel is put into a lathe, and turned in the ordinary manner of turning iron tyres, when it acquires all the appearance of a common railway wheel, but with an outer wooden rim, and the flange only of iron. Mr. Dircks proposes the use of either hard or soft woods, and of various chemical preparations, to prevent the admission of water into the pores of the wood; he also contemplates the using of wood well compressed. The several advantages which this wheel possesses are represented by him to be—that the wooden tyre will wear a considerable time without requiring any repair—that the tyre can be refaced by turning it up again in the lathe, as with worn iron tyres—that it can be retyred with wood, at little expense, and at a far less loss of time than usual—and that, both in the operations of refacing old tyres, or putting in new wood, the work can be performed without the usual labour and cost of removing the wheels from the axles, which, in keying and unkeying, is known to be very troublesome. In regard to their working, it is an opinion, in which Mr. Dircks said he was borne out by experiment as well as by the opinion of practical engineers, that it will work smoother and easier than iron tyred wheels, with the advantage of going well in wet weather and upon inclines—entirely obviating the necessity of dropping sand on the rails. One very important advantage yet remains, and that is, that the rails themselves will suffer less wear by using these wheels, and the fastenings, sleepers, and blocks not be so much injured; indeed, if they answer to the extent that seems to be with reason expected, it is possible that they will have the effect to bring cast iron wheels into more general use.

It is well known that a road laid on stone blocks is kept up at a lower rate than when laid on wooden sleepers, and the only reason for laying them aside, arises from the tremulous motion which iron wheels occasion on the rails. In most cases stone blocks are still used, where they can be applied with safety, in preference to wooden sleepers. On the Kingstown and Dublin Railway, the rails were originally laid on granite sleepers, but the tremulous motion just adverted to was so great, and likely to prove so disastrous, by loosening the rails, together with the consequent damage sustained by engines and carriages passing along the line, that they were ultimately all taken out to lay down longitudinal wooden sleepers. Now, there is every reason to believe, that in all such cases, the effect of these wood-tyred wheels would be, by obviating this injurious tremulous motion, to favour the continued employment of stone blocks in the laying of railways—an advantage, upon the importance of which, as being well understood, it will not be requisite to enlarge here. This new construction and simple adoption of wood makes excellent driving-wheels for locomotives. The wood by use becomes exceedingly close and firm, acquires a smooth surface, does not prevent the ringing of the wheels when hammered, and in outward appearance is not easily distinguished from metal.

Mining Review.

New System of Lockage for Canals.

To avoid the present expensive construction of locks and their waste of water, Mr. Smith, of Deenston, proposes to divide the canal into a series of basins, the water levels of which should be from 12 to 18 inches above each other. The extremity of each basin is so constructed as to permit only the free passage of a boat; in this is placed a single gate, hinged to a sill across the bottom, the head pointing at a given angle against the stream, and the lateral faces pressing against rabbets in the masonry. The gate is to be constructed of buoyant materials, or made hollow so as to float and be held up by the pressure of the water in the higher level; on the top is a roller to facilitate the passage of the boats. When a boat is required to pass from a higher to a lower level, the bow end, which must be armed with an inclined projection, depresses the gate as much as the depth of the immersion of the boat, and as much water escapes as can pass between its sides and the walls of the contracted part of the basin. The same action takes place in ascending, except that a certain amount of power must be expended to enable the boat to surmount the difference of level between the basins. The quantity of water wasted by each boat would be in proportion to its immersion and the speed at which it passed over the gate. In case of different sized boats passing along the same canal, it is proposed to have a small gate forming part of the main gate, so as to avoid the loss of water which would ensue from the whole width being open for the passage of a small boat. This system has only been tried by models; but it is proposed to make an essay on an extensive canal next summer, when the results will be communicated to the Institution.—*Trans. of Inst. Civ. Eng.* Mech. Mag.

Draining the Haarlem Lake.

M. Dietz, a celebrated Dutch engineer, has invented a machine which it is supposed will be adopted for this purpose, and by means of which he calculates that 100,000 cubic ells of water may be drained off daily. This ingenious person estimates the body of water contained in the Haarlem Sea, at 770,000,000 of cubic feet, to empty which it would require ten of his machines of 30 horse power each, the quantity drained off by them daily being 1,000,000 of cubic feet, thus making the period required for its entire removal 800 days. The estimated expenditure of this work, second only in grandeur and importance to the Thames Tunnel, is as follows:—

	Florins.
Ten machines, at 30,000 florins each	300,000
Coals, &c., 500 florins per diem for 800 days	400,000
Sixty workmen at 1½f. each per diem for 800 days	72,000
Superintendence, plans, &c.	25,000
Total, - - - -	797,000
About - - - -	£68,416

Report on a Pantograph, presented by M. Legey. *By* M. Francœur.

The pantograph is an instrument of the greatest utility in reducing drawings to smaller dimensions, and it is sometimes used in amplifying them or in copying them of the same size. But the uncertainty of the adjustments prevent entire confidence in the precision of the designs thus executed; and this instrument is rarely employed in cases where it is indispensable that the lines should be extremely accurate in this relation, particularly when the drawings are on a large scale.

The pantograph of M. Legey has the same form, and is founded on the same principles as those in common use; only he has applied to its execution all the care which his previous labours have rendered him so capable of. It would be too tedious to enter here upon all the details of the minute perfections to which he has brought its construction; we shall designate only the principal parts.

The branches of the instrument are not flat rulers in wood or brass, as heretofore, but tubes, bench drawn, which give to the system more lightness and solidity. These branches can no longer bend under their weight. Screws of adjustment render the plane of the instrument exactly parallel to that of the table which bears it. The rollers are disposed so as to support the instrument in the best manner in all its movements. The axis round which the principal points of junction are pivoted, though solidly arranged, are susceptible of receiving slight displacements in order to regulate the instrument; for we know that the branches must rigorously form a parallelogram in all their positions, and that the fixed points round which the rotation is made must be precisely on the right line passing through the pencil and the stylet which traces the drawing. The author has also designed to allow of slight movements to certain supports of the stylet and the crayon, in order that the straight line, either in one direction or the other, should be perpetually preserved; for we know that the precision of the result depends essentially on these conditions.

In conclusion, the pantograph of M. Legey appears to us to be executed with care, and formed upon the best principles. It is, moreover, of such large dimensions, that it has served to reduce the plan of the city of Arras, and produce a drawing of a metre and a half in width. The most favourable testimony has been furnished us in this respect by Captain Bichot, of the Engineers who performed the work.

Signed, Francœur, Reporter.

Bull. d'encour. Nov. 1839.

Mechanics' Register.

New Post Office Regulations in England.—Seeds sent by Post.

We have lately received not only seeds, cuttings, and scions, but even entire plants, and yesterday a shrub, roots and branches, (Vac-

cinium humifúsum), in a penny letter. From Messrs. Sang, of Kirkcaldy, we received a prepaid packet very neatly done up, containing the seeds of twelve kinds of annuals, each with the name printed, and the price of the whole twelve only 1*s*. If this does not lead to the general distribution of every useful and ornamental plant of which seeds are procurable, the fault will be in the public, not in government. We only wish that the foreign postages could be lowered a little, that our ornamental annuals might be sent all over the Continent; for, it is a fact that will not be denied, that annual plants, even those of warm climates, make a far more splendid appearance in Norway, Sweden, Russia, and the North of Germany, than they do in England, owing to the brighter sun and longer days of these countries during the summer season. Great part of the Californian annuals might be naturalised in the woods of Norway and Sweden, and many superior varieties of bread corn, and of pasture grasses and herbage plants, might be intrôduced into these countries by post, if the postage abroad were only a little lower. An interchange of seeds amongst all the curators of botanic gardens in Europe and America is a result to be anxiously desired, not merely by the botanist, but by the horticulturist and the farmer. If ambassadors were what they ought to be, matters of this kind would have been attended to long ago.—*Cond.*

Gard. Mag.

Southern Magnetic Expedition.—Extract of a Letter from an Officer of H. M. S. Erebus, 7th February, 1840.

"On the 20th November, we left Porto Praya, and December 2nd and 3rd examined and took observations on a cluster of rocks called St. Paul,—evidently the summit of a submarine peak. The sea would make a clear breach over them in blowing weather, consequently nothing vegetable is found. The geological specimens will prove interesting; their general character plutonic, with blue lava and conglomerate. Crabs and sea birds were breeding, and the rocks are quite white with the dung of the latter.

"December 17th we landed on Trinidad, to make magnetic observations, and December 24th we crossed the magnetic equator, in latitude 14° 1′ S, after which in the teeth of a S. E. trade, we worked up to St. Helena, having completed a chain of dips from England to that place.

"Perhaps the most interesting of our achievements will be the fact of our having gained bottom, at two thousand four hundred and twenty six fathoms, in latitude 27° 24′ S. longitude 17° 30′ W., both ships being becalmed on the edge of the S. E. trade. A line of 3600 fathoms of spun-yarn being prepared, a weight of 72 lbs. was attached to it, and two boats were lowered to buoy up the line. The first 100 fathoms took 35 seconds reeling off,—the last nearly 6 minutes; we lifted the lead more than once, but of course the spun-yarn broke in the attempt to haul it up." Naut. Mag.

To the Committee on Publications of the Journal of the Franklin Institute.

Gentlemen,—Mr. John Downes, of Worcester, Mass., having kindly offered to make the computations for the announcement of the Lunar Occultations of the fixed stars for the year 1841, I herewith forward you those for February, March and April, which have been calculated by Mr. Downes from a list selected by E. O. Kendall and myself. Mr. Downes is already favourably known as the computer of the Astronomical portion of the Boston Almanac. It is almost needless to add that his computations of the Lunar Occultations for January and February for Philadelphia agree precisely with those made for the same phenomena by Mr. Kendall and myself. As our other avocations render somewhat onerous the labour of making the announcements, which was sustained by myself without aid from 1834 to 1836—and since that date by Mr. Kendall and myself—our duplicate computations saving the necessity of a separate review,—we have gladly accepted the very disinterested offer of Mr. Downes, and would respectfully recommend his computations to the favourable notice of that portion of the readers of the Journal who are interested in kindred pursuits.

Yours respectfully,

Sears C. Walker.

Philadelphia, December 30th, 1840.

LUNAR OCCULTATIONS FOR PHILADELPHIA, FEBRUARY, 1841.
COMPUTED BY JOHN DOWNES.

Angles reckoned to the right, or westward, round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜

Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
4	16	34	Im. δ Cancri	4.5	19°	73°
4	17	13	Em.		287	340
5	18	30	Im. 18 Leonis,	6	13	64
5	19	2	Em.		294	343
			MARCH, 1841.			
1	6	0	Im. C Tauri,	4.5	142	117
1	6	26	Em.		200	169
9	14	25	N. App. ☽ & 75 Virginis 6, ☽ south 1′.1			
25	20	18.82	Im. Venus. External contact.		130	79
25	20	19.73	" " Internal "			
25	21	10.87	Em. " " "		275	221
25	21	12.82	" " External "			
26	7	42	N. App. ☽ & 7 Tauri 6, ☽ south 0′.5			
29	12	19	Im. 37 Geminorum,	6	117	176
29	13	6	Em.		210	260

LUNAR OCCULTATIONS FOR PHILADELPHIA, APRIL, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
2	8	42	Im. 48 Leonis,	5.6	104°	83°
2	9	30	Em.		181	177
13	15	47	Im. 4 Capricorni,	6	154	120
13	16	50	Em.		247	225
14	8	58	Im. θ Capricorni,	5.6	67	116
			Em. below the horizon.			

Meteorological Observations for November, 1840.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	36	52	30.00	30.05	W.	Moderate.		Clear—do.
	2	39	52	.20	.26	N.E.	do.		Clear—do.
	3	36	56	.20	.08	E.	do.		Clear—do.
	4	46	59	29.98	29.98	N.E.	do.		Hazy—do.
	5	39	58	.95	.90	N.E.	do.		Hazy—do.
	6	44	50	.86	.86	W.	do.		Partially cloudy—do.—do.
	7	41	63	.90	-95	W.S.E.	do.		Clear—do.
	8	44	49	.84	.76	E.	do.	.26	Cloudy—rain.
☉	9	46	48	.70	.64	W.	Brisk.		Cloudy—do.
	10	48	54	.70	.76	N.W.	do.		Cloudy—clear.
	11	38	52	.90	.90	N.W.	Moderate.		Clear—do.
	12	42	52	.80	.80	W.	do.		Cloudy—clear.
	13	40	53	.75	.75	W.	Brisk.		Clear—do.
	14	34	50	.90	.85	W.	Moderate.		Hazy—do.
	15	44	44	.50	.50	W.	Brisk.		Cloudy—do.
☽	16	33	42	.75	.80	W.	Moderate.		Partially cloudy—do.—do.
	17	29	40	.75	.80	W.	do.		Partially cloudy—do.—do.
	18	32	32	.76	.50	N.E.	do.	.50	Snow—do.
	19	30	56	.56	.60	W.	do.		Cloudy—do.—do.
	20	34	40	.85	.90	W.	do.		Clear—do.—do.
	21	26	42	30.05	30 05	W.	do.		Clear—lightly cloudy.
	22	36	43	29.90	29.75	S.E.	do.	1.65	Cloudy—rain.
⊗	23	56	52	.40	.40	S.W.	Brisk.		Cloudy—flying clouds.
	24	35	46	.95	.96	W.	Moderate.		Clear—do.
	25	36	44	.90	.80	N.E.	do.		Cloudy—rain.
	26	36	40	.60	.60	W.	do.	.34	Cloudy—snow.
	27	30	37	.86	.94	W.	Brisk.	.20	Clear—do.
	28	28	44	30.05	.97	W.	Moderate.		Clear—do.
	29	36	52	29.94	.58	S.W.	do.		Clear—do.
	30	46	35	.70	.65	S.W.	do.		Cloudy—hazy.
	Mean	36.77	78.55	29.81	29.79			2.95	

	Thermometer.		Barometer.	
Maximum height during the month.	60.00	on the 2nd.	30.26 on	the 2nd.
Minimum " "	26 00	on the 21st.	29.40 "	23rd.
Mean	57.66		29.80	

									Hygrometer.						
	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
1	5⅓	1⅓	2	1⅔	4⅔	⅔	.	1⅓	....	.	....	....	.	1182
2														
3	8	.	1⅔	⅔	8⅔	.	.	1	....	.	.....	....	.	1176
4														
5	8	.	.	.	8	.	.	4	....	.	.. ..	....	.	1164
6	4	.	7⅓	1⅓	2⅓	.	.	7⅓	....	.	.....	....	.	1174
7	6⅓	.	3	.	3⅔	⅓	1⅓	⅓	....	.	......	....	.	1159
8	.	.	.	.	.	.	.	.	....	.	......	....	.	1173
9	3	.	7	⅓	7⅔	⅔	6⅓	.	....	.	.....	....	.	1205
10														
11														
12	4	.	3⅓	3	10⅓	.	⅓	3	....	.	......	....	.	1158
13														
14	5⅓	⅔	2	⅔	6⅓	⅓	.	2⅔	60.04	1	.....	....	.	1171
15	2	1⅓	⅔	⅔	6⅓	⅓	.	⅔	68.08	2	.....	70.74	2	1181
16														
17														
18	5	.	6	.	7	.	.	1	63.20	1	......	....	.	1150
19	.	.	5⅓	⅓	5⅓	⅓	1	2⅓	....	.	.....	72.14	3	1151
20														
21														
22														
23														
24														
25														
26	3⅔	.	2	.	2⅓	.	15⅓	4	....	.	.....	....	.	1180
27														
28														
29	4	.	5	1⅓	1⅔	.	5⅓	⅓	....	.	.....	....	.	1212
30														
31	.	.	21	.	.	.	.	⅔	....	.	.....	....	.	1192
32	3	⅓	4⅓	⅔	3⅔	.	4⅔	8⅔	....	.	.....	....	.	1168
33														
34	2⅔	.	13	.	2⅔	.	.	2⅔	....	.	.....	75.57	1	1204
35														
36	2⅓	1⅓	5⅔	⅔	6	1	6	3⅓	....	.	.....	....	.	1154
37	2⅓	6	1	11⅓	1⅔	⅓	.	⅓	....	.	.. .	....	.	1152
38	4⅔	1⅓	4⅔	1⅓	⅔	.	11⅔	1	....	.	.....	....	.	1161
39	4	.	6⅔	.	5	.	12⅛	.	....	.	...	....	.	1163
40														
41	8	.	⅔	.	2	.	14	.	....	.	....	....	.	1169
42	⅔	.	.	.	9⅓	.	.	16⅔	....	.	.....	....	.	1162
43														
44														
45	0⅓	.	5⅔	.	4⅓	.	4	.	....	.	.....	....	.	1269
46														
47	3	.	10	⅓	3⅔	.	6⅓	⅔	65.03	11	......	70.11	13	1157
48														
49	1⅓	⅓	1	1	13	.	9	⅔	....	.	.....	....	.	1229
50	2⅓	.	14	.	2⅓	.	.	.	....	.	.....	....	.	1153
51														
52	4⅓	.	5⅔	⅓	6	.	2⅔	1⅔	....	.	.....	....	.	1170
53	2⅔	⅓	5⅓	2	3	.	4⅓	.	....	.	.....	....	.	1179

METEOROLOGICAL REPORT FOR THE STATE OF PENNSYLVANIA, Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for JULY, 1840.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1	Philadelphia,	Philadelphia,	J. M. Hamilton,	74.86	79.27	73.83	88.00	66.00	75.89	1	58.00	67.14	9
2	Montgomery,												
3	Bucks,	Newtown,	L. H. Parsons,	73.10	80.20	67.10	88.00	59.00	73.47	⅓	50.00	59.50	.
4	Lehigh,												
5	Northampton,	Easton,	Charles Elliot,	67.50	76.83	69.10	88.00	60.00	71.14	1⅓	....	....	.
6	Monroe,	Stroudsburg,	A. M. Stokes,	73.96	81.89	70.00	90.00	52.00	75.28	12	....	....	.
7	Pike,	Milford,	Ralph Bull,	60.19	73.87	65.45	87.00	46.00	68.17	.	46.00	58.55	.
8	Wayne,	Honesdale,	W. Richardson,	63.64	81.64	63.85	89.00	52.00	69.71	17	50.00	56.12	23
9	Susquehanna,	Silver Lake,	E. Rose,	66.94	78.06	68.39	94.00	58.00	71.13	.	44.00	59.00	.
10	Luzerne,	Wilkesbarre,	W. F. Dennis,										
11	Schuylkill,												
12	Berks,	Reading,	C. F. Egelmann,	71.82	77.29	68.50	86.00	56.00	72.54	3	...	...	.
13	Chester,												
14	Delaware,	Haverford,	Haverford School,	71.81	79.31	71.66	88.00	59.00	74.26	1⅓	58.00	66.00	1
15	Lancaster,	Lancaster,	Conservatory of Arts,	69.63	81.98	71.13	92.50	60.00	74.25	⅔	54.00	65.79	.
16	York,												
17	Lebanon,												
18	Dauphin,	Harrisburg,	J. Heisely,	73.20	81.27	77.55	90.00	63.00	77.34	1	59.00	68.60	1
19	Northumberland,	Northumberland,	Andrew C. Huston,	70.10	78.95	72.02	89.00	63.00	73.69	2⅔	46.00	58.62	2
20	Columbia,	Danville,	C. H. Frick.										
21	Bradford,												
22	Tioga,												
23	Lycoming,												
24	Union,												
25	Mifflin,												
26	Juniata,	Mifflintown,	J. A. Rinkead,	62.40	81.30	67.38	90.00	51.00	70.36	3⅓	....	....	.
27	Perry,												
28	Cumberland,	Carlisle,	Prof. W. H. Allen,										
29	Adams,	Gettysburg,	Prof. M. Jacobs,	68.13	82.26	71.25	94.00	53.75	73.88	.	50.00	61.64	.
30	Franklin,												
31	Huntingdon,	Huntingdon,	Jacob Miller,	68.00	83.13	70.77	90.00	58.00	73.97	⅔	....	....	.
32	Centre,	Bellefonte,	John Harris,	66.31	83.11	68.80	90.00	51.00	72.74	7⅔	....	....	.
33	Potter,												
34	M'Kean,	Smithport,	Richard Chadwick,	61.48	79.81	60.03	93.00	42.00	67.11	.	59.00	53.77	.
35	Clearfield,												
36	Cambria,	Ebensburgh,	Richard Lewis,	62.21	78.52	63.87	89.00	52.00	68.20	3⅓	44.00	55.59	4
37	Bedford,	Bedford,	Samuel Brown,	71.60	80.54	72.11	90.00	62.00	74.75	⅓	....	....	.
38	Somerset,	Somerset,	George Mowry,	62.79	74.31	63.20	83.50	51.50	66.77	⅔	44.00	56.76	.
39	Indiana,	Indiana,	Richard White,	73.71	79.13	66.84	90.00	57.00	73.23	.	59.00	50.60	.
40	Jefferson,	Rose Cottage,	C. C. Gaskell,										
41	Warren,	Warren,	C. S. Brown,	66.26	76.52	72.89	85.50	54.00	71.89	.	53.00	65.71	.
42	Venango,	Franklin,	Wm. Connely,	57.81	84.55	66.16	102.	40.00	69.51	.	....	....	.
43	Armstrong,												
44	Westmoreland,												
45	Fayette,	Uniontown,	J. P. Weithers,	69.29	85.10	69.79	98.00	55.00	74.73	.	....	....	.
46	Green,												
47	Washington,	Cannonsburg,	A. H. Campbell,	64.81	77.94	70.58	88.00	53.00	71.11	.	50.00	61.47	3
48	Alleghany,	Pittsburgh,											
49	Beaver,	Beaver,	Wm. Allison,	69.06	83.79	71.94	95.00	60.00	74.93	⅔	....	....	.
50	Butler,	Butler,	Jacob Mechling,	66.26	80.00	72.35	90.00	56.00	72.87	.	....	....	.
51	Mercer,	West Greenfield,	S. Campbell,										
52	Crawford,	Meadville,	J. Limber,	71.48	78.62	69.13	88.00	60.00	73.08	1⅓	50.00	62.55	.
53	Erie,	Erie,	Park & Reid,	71.21	76.42	69.03	91.00	55.00	72.22	.	48.00	60.23	.

	County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1	Philadelphia	30.11	30.14	30.13	30.43	29.79	30.13	⅔	15⅔	11	4⅓	....	....	....	..	....
3	Bucks	30.04	30.02	30.02	30.24	29.70	30.03	⅓	19⅓	10⅓	1⅓	7	....	....	..	3.983
5	Northampton	29.97	29.96	29.95	30.18	29.60	29.96	1⅓	.	.	.	....	....	....	..	......
6	Monroe	29.59	29.62	29.58	29.80	29.25	29.60	11⅔	7⅔	11⅓	12	10	....	....	..	4.770
7	Pike	29.60	29.60	29.60	29.84	29.24	29.60	⅓	17	13⅔	⅓	10	....	....	..	3.658
8	Wayne	28.89	28.91	28.89	29.05	28.60	28.90	17	.	.	.	....	....	....	..	......
9	Susquehanna	28.12	28.12	28.12	28.35	27.70	28.12	.	22	9	.	7	....	....	..	2.510
12	Berks	29.92	29.89	29.88	30.10	29.56	29.90	3	13⅔	14⅓	3	5	....	....	1	2.630
14	Delaware	29.57	29.56	29.57	29.80	29.26	29.57	⅔	17⅓	13⅔	.	4	....	....	..	3.229
15	Lancaster	29.57	29.56	29.56	29.79	29.20	29.56	⅔	19	11⅓	⅔	5	....	....	..	1.530
18	Dauphin	29.78	29.79	29.79	29.97	29.50	29.79	1	.	.	.	....	....	....	..	......
19	Northumberland	29.52	29.50	29.49	29.75	29.14	29.50	2⅓	13	15⅓	2⅔	7	....	....	3	1.937
26	Juniata	29.54	29.48	29.52	29.73	29.16	29.51	4⅔	17	9⅓	4⅔	....	....	....	..	......
29	Adams	29.45	29.44	29.44	29.65	29.17	29.45	.	21	9⅔	⅓	5	....	....	..	0.998
31	Huntingdon	29.43	29.40	29.40	29.62	29.06	29.41	⅔	23	8	.	4	....	....	..	0.942
32	Centre	29.33	29.32	29.30	29.50	29.02	29.32	7⅔	16	7	8	5	....	....	..	3.527
34	M'Kean	28.07	28.08	28.07	28.28	27.80	28.07	.	12⅓	18⅔	.	6	....	....	..	2.400
36	Cambria	28.00	27.99	27.98	28.22	27.70	27.99	3⅓	11	14⅓	5⅔	9	....	....	..	3.229
37	Bedford	29.29	29.28	29.27	29.50	28.94	29.28	⅓	15	15⅔	⅓	....	....	....	..	......
38	Somerset	27.93	27.93	27.93	28.10	27.64	27.93	⅔	11⅔	18⅔	⅔	6	...	....	1	3.350
39	Indiana	28.70	28.68	28.70	28.90	28.40	28.70	.	19⅓	11⅔	.	10	....	....	..	3.900
41	Warren	28.92	28.91	28.91	29.15	28.55	28.91	.	20⅔	10	⅓	6	....	...	..	3.849
42	Venango	29.12	29.20	29.24	29.90	28.70	29.19	16⅓	12⅓	2⅓	16⅔	4	....	....	..	2.158
45	Fayette	29.03	29.03	29.05	29.23	28.60	29.03	.	24⅔	6⅓	.	....	....	....	..	......
47	Washington	29.13	29.16	29.15	29.40	28.82	29.15	.	.	.	.	7	....	....	..	3.772
49	Beaver	29.50	29.48	29.47	29.75	29.14	29.48	⅔	18⅓	11⅔	1	6	....	....	..	1.810
50	Butler	28.91	28.90	28.90	29.10	28.60	28.90	.	.	.	.	7	...	....	..	2.399
52	Crawford	28.82	28.82	28.82	29.02	28.48	28.82	1⅓	15⅔	14	1⅓	8	....	....	1	4.054
53	Erie	29.41	29.43	29.43	29.66	29.04	29.42	.	18	13	.	9	....	....	..	3.262

	County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
1	Philadelphia	1	1	2	1	⅔	1⅓	1⅓	⅓	4⅔	⅔	5⅓	1⅓	2	1⅔	4⅔	⅔	.	1⅓
3	Bucks	⅓	.	5	.	⅓	⅓	1	⅔	1⅔	1⅔	8	.	1⅔	⅔	8⅔	.	.	1
5	Northampton	1	.	2⅔	.	3⅓	.	4	.	.	.	8	.	.	.	8	.	.	4
6	Monroe	1	.	.	.	2⅔	1	1⅔	.	2⅓	.	4	.	7⅓	1⅓	2⅓	.	.	7⅓
7	Pike	1⅔	.	1⅓	⅓	1⅔	.	3⅓	⅓	7	⅓	6⅓	.	3	.	3⅔	⅓	1⅓	⅓
8	Wayne	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
9	Susquehanna	.	.	2⅔	.	⅓	.	2⅔	.	⅓	.	3	.	7	⅓	7⅔	⅔	6⅓	.
12	Berks	.	.	2	.	2⅓	⅓	1	.	1⅓	.	4	.	3⅓	3	10⅓	.	⅓	3
14	Delaware	1	⅔	3	⅓	1	⅓	1	⅓	2	3⅓	5⅓	⅔	2	⅔	6⅓	⅓	.	2⅔
15	Lancaster	2	1	2⅓	⅔	⅔	.	2⅓	2	6⅔	1	2	1⅓	⅔	⅔	6⅓	⅓	.	⅔
18	Dauphin	3⅓	.	.	.	⅔	.	3⅔	.	4⅓	.	6	.	6	.	7	.	.	1
19	Northumberland	1	⅓	3⅓	.	⅓	.	3	.	8	.	.	.	5⅓	⅓	5⅓	⅓	1	2⅓
26	Juniata	.	.	⅔	.	⅓	.	2⅓	.	⅓	.	3⅔	.	2	.	2⅓	.	15⅓	4
29	Adams	4⅓	.	⅓	.	2	.	.	⅔	4⅔	1⅓	4	.	5	1⅓	1⅔	.	5⅓	⅓
31	Huntingdon	.	.	.	.	9⅓	.	.	.	.	.	.	.	21	.	.	.	.	⅔
32	Centre	2⅓	.	⅔	⅓	.	⅓	⅓	.	1⅔	.	3	⅓	4⅓	⅔	3⅔	.	4⅔	8⅔
34	M'Kean	⅓	.	.	.	7⅓	.	2	.	⅓	.	2⅔	.	13	.	2⅔	.	.	2⅔
36	Cambria	.	.	⅓	.	⅔	.	⅔	1⅓	1⅓	⅓	2⅓	1⅓	5⅔	⅔	6	1	6	3⅓
37	Bedford	.	.	.	.	⅓	.	4⅔	⅔	.	2⅓	2⅓	6	1	11⅓	1⅔	⅓	.	⅓
38	Somerset	⅔	.	⅔	.	⅓	⅔	1⅓	⅔	1⅓	.	4⅔	1⅓	4⅔	1⅓	⅔	.	11⅔	1
39	Indiana	.	.	.	.	⅓	.	2	.	⅓	.	4	.	6⅔	.	5	.	12⅓	.
41	Warren	⅔	.	⅓	.	.	.	2⅓	1	⅔	1⅓	8	.	⅔	.	2	.	14	.
42	Venango	.	.	⅓	.	.	.	4	.	.	.	⅔	.	.	.	9⅓	.	.	16⅔
45	Fayette	⅔	.	⅔	.	.	.	3	.	2⅓	.	10⅓	.	5⅔	.	4⅓	.	4	.
47	Washington	⅔	⅓	3	.	1⅓	.	⅔	.	1	.	3	.	10	⅓	3⅔	.	6⅓	⅔
49	Beaver	⅓	.	3	.	.	.	1⅓	.	.	.	1⅓	⅓	1	1	13	.	9	⅔
50	Butler	.	.	.	.	10⅔	.	1	.	⅓	⅓	2⅓	.	14	.	2⅓	.	.	.
52	Crawford	1⅓	.	.	.	.	.	⅓	⅓	8	⅓	4⅓	.	5⅔	⅓	6	.	2⅔	1⅔
53	Erie	1	⅓	4⅔	.	⅔	.	⅔	1⅔	3⅔	⅔	2⅔	⅓	5⅓	2	3	.	4⅓	.

	County.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
1	Philadelphia	....	.	....	....	.	1182
3	Bucks	....	.	.....	....	.	1176
5	Northampton	....	.	.....	....	.	1164
6	Monroe	....	.	.....	....	.	1174
7	Pike	....	.	.....	....	.	1159
8	Wayne	....	.	.....	....	.	1173
9	Susquehanna	....	.	.....	....	.	1205
12	Berks	....	.	.....	....	.	1158
14	Delaware	60.04	1	.....	....	.	1171
15	Lancaster	68.08	2	.....	70.74	2	1181
18	Dauphin	63.20	1	.....	....	.	1150
19	Northumberland	....	.	.....	72.14	3	1151
26	Juniata	....	.	.....	....	.	1180
29	Adams	....	.	.....	....	.	1212
31	Huntingdon	....	.	.....	....	.	1192
32	Centre	....	.	.....	....	.	1168
34	M'Kean	....	.	.....	75.57	1	1204
36	Cambria	....	.	.....	...	.	1154
37	Bedford	....	.	.....	....	.	1152
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47	Washington	65.03	11	.....	70.11	13	1157
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FEBRUARY, 1841.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

(Continued from page 11.)

Letter VIII.

New Albany, Indiana, June 15, 1839.

Steam Navigation in the United States.

I have given already, in my second letter, a short extract from a printed document, which was laid before Congress by the Secretary of the Treasury, concerning the steamboats, locomotive and stationary steam-engines, in the United States. Since that time, I have, in my travels, obtained possession of many and important data about the extent, importance, and perfection of steam navigation in the last year. The following is an extract therefrom.

1. *History and Extent of Steam Navigation.*

Fulton, a North American, the inventor of steam navigation, constructed, in the year 1807, the first steamboat upon the Hudson river, to make regular trips between New York and Albany. The voyage of one hundred and forty-five miles was then performed in thirty-three hours. The success of this enterprize laid the foundation of steam navigation in the United States.

Up to that time the barks upon the Ohio and Mississippi were propelled partly by sails, partly by oars and poles; from Cincinnati to New Orleans (sixteen hundred miles), such a bark came down in five weeks, and went up in eighty to ninety days; for its management nine men were required down, and twenty-four to thirty-two up stream. In March, 1811, the first steamboat built by Fulton, in Pittsburgh, called the "New Orleans," was launched on the Ohio, and commenced in December of the same year, to make regular trips between Natchez and New Orleans. The time required to make the trip of three hundred miles between the two places was three days down stream, and seven to eight days up. The boat performed in a year only thirteen trips up and down, or seven thousand eight hundred miles. A passenger paid eighteen dollars for a passage down, and twenty-five dollars for one up stream.

Fulton constructed several other steamboats in the United States. He afterwards went to Europe, to bring into execution there, his important invention; but he found no encouragement in England, and when he proposed in Paris the introduction of steam navigation, he was derided by the French, and Napoleon declared him an adventurer. The prejudice of the public, in England and all Europe, against an American invention, which, in fact, was only a new application of steam power, was so great, that five years elapsed, before Bell, in 1812, constructed the first steamboat at Glasgow, in Scotland. Steam navigation now came more and more into practice in Europe, but has as yet not attained such an extent there, as in the United States.

On the 6th of May, 1817, the first steamboat, the "Enterprize," went up the Mississippi and Ohio, from New Orleans to Louisville, and arrived there on the 30th of May, or in twenty-five days. As the barks at that time required nearly three months for the same journey, the inhabitants of Louisville were in such an ecstacy, that they conducted the Captain, Shrive, around in triumph, and gave him a public dinner. The steamboats upon the western and south-western waters now, were constantly increasing in number, and in 1834, they counted already two hundred and thirty-four; in the year 1838, their number rose to four hundred. In 1831, there passed through the Louisville and Portland Canal, in the State of Kentucky, four hundred and six steamboats, and four hundred and twenty-one flat boats, with a tonnage together of 76,323; in the year 1837, passed through the same canal, fifteen hundred and one steamboats, and only one hundred and sixty-five flat boats, with a tonnage together of 242,374.

In the year 1818, the first steamboat was launched on the great north-western Lakes; in 1835, they were navigated by twenty-five

steamboats, and in 1838, the number of steamboats was seventy. In year 1834, eighty-eight new steamboats were built in the United States; in 1837, or three years after, one hundred and thirty-four new steamboats were launched. The largest ship-yards for building steamboats, are at New York, Philadelphia, Baltimore; at Louisville, New Albany, Cincinnati, Pittsburgh, and St. Louis.

In total, there were in the summer of 1838, about eight hundred steamboats in operation in the United States; the greatest number, in any one State, belonging to New York, viz. one hundred and forty.

The travel in steamboats along the sea-shore has, as I observed in my former letters, been mostly superseded by rail roads, located in a more or less parallel direction to the sea coast; and will probably, when the whole rail road system is completed, entirely cease; but the steam navigation upon the navigable rivers is getting more into practice, its increase in the last two or three years, has contributed much to diminish the navigation with sailing vessels or barks; not only all kinds of merchandise without exception, but also provisions, as grain, flour, meat, etc., are carried in steamboats as well up as down stream, and while the freightage is almost the same as upon the barks and sailing vessels, the goods arrive much sooner at the place of their destination if carried in steamboats, and are therefore less liable to be damaged. But still more has been done. Upon the Ohio river, stone coals are now brought by steamboats, two hundred and fifty miles, down to Cincinnati, or rather the flat boats, loaded with coal, are taken in tow and brought down the river by steamboats, and the empty barks taken back in the same way, because the cost of transportation is found to be less in this manner. It is true, the extremely high wages of the boatmen and all other labourers, contribute much to this extraordinary result; but as I shall have occasion to show, hereafter, the crew of a steamboat is also very well paid, and it is to be ascribed entirely to the perfection in the construction of vessels and the engines used in them, and in the application of steam, as also to the improved arrangements in the steamboats generally, that they have produced in America the results which have been arrived at neither in England nor in any other part of Europe.

The Americans boast of a system of navigable streams in the southern and south-western States not to be met with in any other country of the globe; they maintain that the length of the Mississippi with the Ohio and all other tributary streams, comprises an extent of one hundred thousand miles of waters navigable by steamboats. I would not answer for the correctness of this number, but the Mississippi alone is navigated by steamboats from New Orleans, under the thirtieth degree, to the Falls of St. Anthony under the forty-fifth degree of

north latitude, a distance not less than two thousand miles, and the number of navigable tributary streams of the Mississippi is indeed so large, that a European, who is accustomed to our short travels by steamboats, can only, by being an eye witness, conceive the magnitude of the system of steam navigation in this country. There are daily, at least four or five steamboats starting from New Orleans for Pittsburgh, in the business season, and as many arrive daily, the distance is two thousand miles, or two thirds of that from England to New York across the Atlantic, and nevertheless the voyage is regarded as nothing extraordinary, and is undertaken after a few hours preparation.

2. *Construction of Steamboats and the Engines used therein.*

The steamboats in America, with the steam engines used on the same, are of three entirely different plans of construction. Those upon the eastern waters, comprising the sea along the coast of Boston to Charleston, S. C., and all rivers emptying into the same, have condensing engines, with large upright cylinders, and long strokes, the larger boats draw from five to seven feet water, and go with a speed of from ten to fifteen miles per hour. Upon the Hudson river, the distance from New York to Albany, of one hundred and forty-five miles, is performed in eleven to twelve hours up stream, and in nine to ten hours down stream, including the stoppages at fifteen or twenty landing places, where passengers come on board or leave the boat. I took a passage in the steamboat "North America," on the 23rd of November, 1838, from New York for Albany; as the river was already nearly half frozen over, a great deal of floating ice was coming down; the boat left New York at five o'clock in the evening, and arrived at Albany the following morning at seven o'clock; we made, therefore, including all stoppages, over ten miles per hour up stream. The length of the vessel is two hundred feet, greatest width twenty-six feet; she has two decks, the lower of which, where the engines are, is about three feet above the level of the water; she has two separate cabins; the gentlemen's cabin, which is, at the same time, the dining room, and the ladies' cabin. We were three hundred and twenty passengers on board, each of whom slept in a berth, and as sufficient room appeared still to remain, one may imagine how colossal this floating palace must be. Two steam engines with fifty-two inch cylinders, move the paddle wheels of twenty-two feet in diameter. The pressure of the steam of this, as of most of the steamboats upon the eastern waters is about fifteen pounds per square inch, and the stroke eight to ten feet; the steam is generally cut off at one third or one-half of the stroke, and operates by expansion. For a

voyage of one hundred and forty-five miles, twenty-five to thirty cords (of one hundred and twenty-eight cubic feet), of soft wood are required. The "North America" draws, when loaded, six feet; but there are passenger boats upon other rivers in the east, which draw, when loaded, only twenty-four to thirty inches of water, and move against strong currents.

The steamboats in the west, or upon the "western waters," are, throughout, very flat, and go, when loaded generally five feet deep, some, however, only thirty to thirty-six inches. When the water in a river is only thirty inches deep, the steamboat contains only the engine and fuel, and the cabins for the men, and flat boats loaded with goods are taken in tow. The passenger boats have two decks, the upper one is for the cabin passengers. The elegant boats contain a large, splendidly furnished and ornamented saloon, used as the dining room, and an adjoining saloon for ladies. The saloons are surrounded by small apartments, (state rooms), each of which contains two berths, and round the state rooms is an open gallery, to which a door opens from each state room. Such a vessel offers to an European an imposing and entirely novel aspect. All steamboats upon the western waters have high pressure engines, the pressure of steam being from sixty to one hundred pounds per square inch. Often two engines are used in a boat, and then each engine propels one of the paddle wheels. The cylinders are horizontal, the stroke is eight to ten feet, and the steam is generally cut off at five-eighths of the stroke, and then operates by expansion. The escaping steam is applied to heat the water pumped from the river, before it gets into the boiler.

The third kind of steamboats is to be found upon the lakes in the north and north-west of the Union, they generally go much deeper than the former, are more strongly built, and are propelled partly by condensing, and partly by high pressure steam engines.

3. *Progress of Steam Navigation since its Introduction in the United States.*

The perfection attained in steam navigation may best be estimated after a comparison of the former and present performances of steamboats, and of the former and present rates of charges for transportation of passengers and merchandise.

In the year 1818, a cabin passenger paid for a passage in a steamboat from New Orleans to Louisville, a distance of one thousand four hundred and fifty miles, one hundred and twenty dollars, and for returning, seventy dollars, the passage up, took twenty days, and down, ten days, at present, cabin passengers pay, in the most elegant steam-

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boats, fifty dollars for a passage up, and forty dollars for one down stream; while they go up in six, and down in four days. These charges include boarding, which, considering the abundance and choice of the victuals, &c., ought to be estimated at two dollars per passenger per day. The fare is, therefore, now, for the passage alone, taking the average between a trip up and down, (excluding board,) 2.41 cents per mile. Less elegant boats take cabin passengers up, in eight days, for thirty dollars, and for twenty-five dollars down, in five days, which, after deducting one and a half dollars per day for board, gives only 1.22 per mile, at an average between a trip up and down.

Upon the lower deck of these steamboats, which is a few feet above the surface of the water, are the deck passengers, who provide their own meals, and pay for the same passage of one thousand four hundred and fifty miles, only eight dollars; if they assist the crew in carrying wood upon the boat, they pay only five dollars. In the former case, they pay, therefore, per mile, 0.55 cents.

Merchandize was carried, before the introduction of steam navigation, in sailing vessels, which took a load of one hundred and fifty tons; in the year 1817, the charge for freight per pound, from New Orleans to Louisville, was seven to eight cents; in 1819, the *steam-boats* commenced carrying freight, and immediately reduced the charge to four cents per pound. At present, the charges per one hundred weight, from New Orleans to Louisville, are according to the quality of the goods, and the season, at least thirty-three cents, and at the most, one and a half dollars; at an average they may be taken at sixty-two and a half cents for the distance of one thousand four hundred and fifty miles. This makes 0.86 cents per ton per mile.

Between Cincinnati and Louisville, the first steamboat, "General Pike," was put in operation in 1819, and made, weekly, a voyage down to Louisville, one hundred and fifty miles, in eighteen hours, and up again to Cincinnati in forty hours. A cabin passenger paid at that time twelve dollars for a passage. At present, the steamboats have so much increased in number, that at least six boats are daily starting from and arriving at Cincinnati or Louisville. Upon the finest boats, as for instance, the "Pike" and "Franklin," the fare is four dollars, and the time occupied in going up, is, including all stoppages, fifteen hours, and in going down only eleven hours; but these boats have frequently made a passage up in twelve, and a passage down the river in seven and one quarter hours; in the latter case, the speed was therefore over twenty miles per hour. If one dollar be deducted for board, there remain three dollars for the passage, which is at the rate of two cents per mile. The deck passengers who assist

in taking in wood, pay only one dollar or two thirds of a cent per mile, and find their own victuals. For merchandize, the charges are fifteen cents per one hundred weight, or two cents per ton per mile.

From Cincinnati to St. Louis, the voyage is five hundred and thirty-eight miles down the Ohio and one hundred and ninety-two miles up the Mississippi river, making together seven hundred and thirty miles. The passage to St. Louis, or from there back, is performed in four days. A cabin passenger pays twelve dollars, of which we ought to deduct at least four dollars and seventy cents for board, this leaves only one cent per mile for the passage alone. The deck passengers pay four dollars without board, which makes nearly one half cent per mile. Goods pay, at an average, fifty cents per one hundred weight, 1.37 cents per ton per mile.

Upon the Hudson river, the passage fare is, in the most elegant boats, three dollars for the distance of one hundred and forty-five miles between New York and Albany, which gives two cents per passenger per mile ; for meals an extra charge is made. In less elegant steamboats, passengers are carried the same distance for one dollar, and at this moment even for fifty cents, which gives only one third of a cent per mile.

From the above data we may infer that, at an average, cabin passengers upon the American rivers pay according to the elegance of the steamboats, from two and a half cents down to one cent per mile (board not included), and deck passengers only about one half cent per mile ; both travel, taking the average between up and down stream, with a speed of twelve miles per hour. Goods upon the same steamboats are carried, at an average, for one and one third cents per ton per mile.

These striking results, which are attained nowhere else, are chiefly derived from the improvements constantly made in the construction of the boats and their engines. Of the eight hundred steamboats at present navigating the American waters, hardly two will be found of an entirely similar construction ; the steam engines, though subject to the same principles of steam power, differ from the English in nearly all their parts. But, three years ago, eight days were required for a trip from New Orleans to Louisville, which is now regularly performed in six. The most remarkable result is, that a boat of four hundred tons required, twenty years ago, for this voyage of one thousand four hundred and fifty miles, three hundred and sixty cords of wood, while at present, for a six days passage, only the same quantity of wood is required.

4. *Rise of Wages, and of the Prices of all Requisites for Steamboats during the last Year.*

What appears most striking, is, that while the charges for transportation have been constantly *reduced* during twenty years, wages and the prices of all commodities *rose* from year to year. The Captain of a steamboat received twenty years ago, a salary of one thousand dollars per year, now he gets upon the better boats, two thousand dollars. Every steamboat has two pilots, who change every four hours; each of them received, in 1822, only sixty dollars a month, but since that time their salary has risen, and was, in 1833, three hundred dollars, which is still now paid to the pilots of the best boats; there are also two engineers upon each steamboat, their salary was, in 1822, only forty dollars per month, and rose in consequence of the great demand for engineers, to one hundred and one hundred and fifty dollars. The firemen and common labourers received, twenty years ago, only fourteen dollars per month, and get now thirty to forty dollars. The whole crew, besides, have free board upon the steamboats.

The provisions necessary for the nourishment of the passengers upon the steamboats, have risen in price during the last five years, thirty-three per cent.

The steamboats upon the western waters use, almost exclusively, wood as fuel for the engines, which, twenty years ago, was quite valueless; in 1834, it sold on the Ohio and Mississippi, for one and three quarters to two dollars per cord, and costs at present two and one quarter to three and one half dollars; the price has therefore increased in the last five years, about fifty per cent.

5. *Cost of Steamboats.*

The steamboats upon the western waters, whose plan of construction might be adopted to great advantage upon our rivers in Europe, are, as I observed already, principally constructed in Louisville, Cincinnati, and Pittsburgh. Generally, the hull of the vessel is built by ship carpenters, the steam engine delivered from a manufactory, and put on the boat, after which the joiners build the cabins and finish the whole. Three different classes of mechanics are therefore required, with whom separate contracts are made; there are, however, individuals who undertake the building and furnishing of a whole steamboat by contract. As the prices differ much according to the solidity and elegance of the vessels, I herewith state the cost of some of the steamboats, which are among the best.

Between Cincinnati and Louisville, the two steamboats, "Pike" and "Franklin," make regular trips, carrying the United States mail;

one of the two goes daily up, the other down, the river. The "Franklin" is one hundred and eighty-three feet in length at her deck, and the extreme width is twenty-five feet, the depth of hold, or the distance from the keel to lower deck, is six and one half feet. The tonnage two hundred ton. Upon the upper deck are forty-two state rooms, each with two berths, making, in all, eighty-four berths; but matrasses are laid upon the floor of the dining room, when required, and one hundred and fifty cabin passengers may sleep upon the boat. The boat is propelled by two engines, the pressure of steam is eighty pounds per square inch, the diameter of the cylinders, which are in a horizontal position, is twenty-five and one half inches, the stroke seven feet. The steam is cut off at five-eighths of the stroke, and acts through the remaining three-eighths by expansion. The diameter of the paddle wheels is twenty-two feet, their width eleven feet, the dip is twenty-two inches, the paddle wheels generally make twenty-eight revolutions in a minute. The length of the connecting rod is twenty-three feet. There are six boilers of wrought iron on board the boat, each twenty-three feet in length and sixty inches in diameter, each boiler has two flues of fifteen inches diameter.

At an average, the steamboat carries one hundred and twenty-five passengers, one half in the cabins, and the other half on deck, and besides twenty-five tons of goods. With this load she draws six feet water. The boat was constructed in the year 1836, and the cost was:

For the hull, at twenty-five dollars per ton, -	$5,000
" two steam engines, - - -	12,000
" joiners work for cabins, - -	4,000
" draperies, mirrors, bedding, and other furniture in the state rooms, saloons, and kitchen,	9,000
Total, - -	$30,000

This boat is, as observed, one of the most solid and elegant; other steamboats of the same dimensions have cost five thousand to six thousand dollars less.

Amongst the steamboats of the largest class, which run only between New Orleans and Louisville, the "Sultana" and the "Ambassador," are now much favoured by the public; the "Ambassador" has two hundred and fifteen feet length of deck, and thirty-five feet extreme breadth. Her tonnage is four hundred and fifty. On the upper deck are forty-four state rooms, each with two berths, but as many beds may be arranged upon the floors of the saloons. Of the two steam engines, each has a horizontal cylinder of twenty-five inches diameter and eight feet stroke; the steam acts with a pressure of ninety pounds per square inch, and is cut off at five-eighths of the

stroke. The diameter of the paddle wheels is twenty-two feet, their width twelve feet. The boat generally carries two hundred tons of goods up, and three hundred tons down stream, besides one hundred cabin and one hundred and fifty deck passengers; she draws, empty, five feet, and when loaded, seven feet water. The hull of this boat has cost twelve thousand dollars, the engines seventeen thousand, the joiners work, and the whole inner arrangement of this highly elegant structure, amounted to thirty-one thousand dollars, making the cost of the whole boat sixty thousand dollars. It must, however, be observed that great and costly alterations were made during the construction, so that her cost would actually not exceed fifty-five thousand dollars.

Well instructed individuals, who are very much interested in the subject of steam navigation, estimate the average cost of a steamboat upon the eastern waters, at forty-five thousand to fifty thousand dollars, upon the western waters, after a special calculation, at twenty-three thousand five hundred dollars, and upon the lakes, the average between the two, or at thirty-five thousand dollars. Consequently all the steamboats, which were in operation in 1838, have cost as follows, viz.

351	boats upon the eastern waters, at	$47,500	$16,672,500
385	" " western "	23,500	9,047,500
64	" " lakes, "	35,000	2,240,000
800	steamboats, each at an average cost of	$34,950	27,960,000

Now, as since the introduction of steam navigation, thirteen hundred steamboats were built in the United States; the whole capital invested by the Americans in steamboats, amounts to forty-five millions four hundred and thirty-five thousand dollars, the greater portion of which has been expended in the last five years.

To be continued.

Notes of an Experiment with Locomotive Engines. *By* George W. Whistler, Esq., Civ. Eng. W. R. R.

It is the custom to speak and write of Locomotive Engines in reference to their *power* almost exclusively; hence we frequently see in the public prints notice of the performances of engines where the extraordinary results (if they be extraordinary) are set forth to show the superior power of the engine, and accompanied too with remarks calculated, if not intended, to lead the reader to believe that the builder, by some invention or peculiar mode of construction of his own, had

succeeded in producing a greater effect from the same cause than had heretofore been accomplished.

That one engine may be of superior power to another of course is true; just as true as that one house may be of greater capacity than another and for the same reason; because it is built to order on a large plan; but it must be equally true than an engine can have no greater power than is *due to the capacity of its boiler to generate steam*, and that the effect produced by this power can be no greater than is *due to the available weight of the engine for adhesion.* Yet it is sometimes stated that the engines of one maker with less available weight (weight on the driving wheels) than those of any other maker, have superior power and will draw much heavier loads.

To those at all acquainted with the present state of the locomotive engines, and the mode of construction pursued by almost all makers, both in this country and in Europe, to whom the causes for effect are obviously of so definite a nature, and so perfectly limited in every case —being subject to order—such statements and assertions seem strange and unaccountable; it is in fact to say that one pound used as a power will produce a greater effect than another pound, or more distinctly, that the gravity of one pound is greater than the gravity of another pound; and it must be attributed to the apparent inutility of contradicting such absurdities that these statement have been permitted to pass unnoticed. But since it is so apparent that few, if any, will take the trouble to investigate and understand the causes and effects in this machine, but rather treat all questions relating to it as matters of veracity, apparently regardless of the absence of all probability or even possibility of such effects from such causes, I am induced to offer the result of a recent trial on this road of two engines of different makers to ascertain their relative *effective* power.

I am the more induced to do this, because I conceive the growing faith in these oft repeated and undenied statements of superior and *peculiar* power, is not only injurious to the builders themselves, but to the true interests of rail road companies.

It is of serious injury to rail road companies because it induces them, in the expectation of rapid improvements, to limit themselves too closely in their first outfit, and then in the expectation of procuring something of superior and peculiar power, they are induced to go from maker to maker as each may set forth such claims; thus collecting a variety of pattern destructive of that uniformity in the several parts of the engine, which by affording the facility of shifting parts from one to another, or applying parts common to all, is so essential to the economy and despatch of the operations of the road. This variety of pattern and make on any road creates an equal variety of opinion

and prejudice among the agents of the road, for and against engines of different makers, equally prejudical to the maker and the company; when in fact there may not, and among makers of reputation (so far as power is concerned) there is not any other difference than may be the result of the architectural fancy of the builder, sufficient, however, to destroy all uniformity; and I am fully of opinion that this uniformity is of such importance, that all deviations should be avoided until the advantages of a change are of such an obvious nature as to render a total change desirable.

I presume the advantages of this uniformity in the parts of engines cannot be doubted. I have no hesitation in saying (and my experience leads me to it) that a given number of engines with perfect uniformity of parts, permitting the immediate shifting of parts from one to another will perform more, much more, work than the same number equally good in themselves but all differing from each other, and that there are great advantages too in having all the engines on one road of the same make I think will be admitted, when, wherever this is found to be the case on any road, there you find the engines in the best order, and enjoying the best reputation; and whether this be the effect of the prejudices of those who use them, or their faith and natural pride in the good qualities of *their engines* where all are alike, instead of the variety of opinion and equally natural prejudice in favour or against engines of particular makers where all are different; the public is there less incommoded and the company less prejudiced by the delays consequent upon accidents to, or defects in the engines.

Another injurious effect upon rail road companies, and likely to be more serious in its consequences is, that this faith in the superior and *peculiar* power of engines, leads to expectations of almost unlimited effects; at least to such extent that almost any grade could be ascended without the least inconvenience: in short, expectations that could never be realized without some special dispensation of the law of gravity; yet in conformity with these expectations it is frequently urged that roads should be constructed (with reference to cheapness) to conform nearly to the natural surface of the ground, regardless of steep grades, since engines had been *invented*, or certainly soon would be, with power to ascend the steepest as easily as they had heretofore on a level—and engineers are not unfrequently placed in the embarrassing predicament to be overwhelmed with *facts and statements!* in relation to the superior and mysterious effects of engines, depriving them of the immutability of nature's law of gravity to found an argument on.

The Locomotive is a steam engine of the most simple form, and the general plan of construction pursued by almost all makers is essen-

tially (so far as power is concerned) the same. The boilers, the source of power in all, are similar,* being cylindrical, horizontal and tubular; the only difference being that some have square or rectangular furnaces, and others have circular or rounded furnaces; each, however, being able to generate steam sufficient to overcome the adhesion due to the weight of the engine; indeed, this is understood by all good makers to be a necessary condition, and all that I am acquainted with accomplish it.

The reciprocating motion of the piston is applied directly by means of slides and a connecting rod to produce a circular motion of the wheels, either by a crank in the wheel axle, or (which is the same) to a pin in the spoke of the wheel; the effect is precisely the same in both, and if the adhesion between the wheel and the rail be greater than the resistance to progressive motion of the engine and train (from friction and gravity) then will the whole advance; but if it be not, and there be steam power sufficient to overcome what adhesion there may be (and all engines have this power) then will the engine and train remain stationary, while the wheels turn round, slipping, on the rails; and no additional application of steam power can cause it to advance; to say otherwise would be so say, that if I *(having strength sufficient)* should break a lever in attempting to lift a weight, another, *because he has greater strength*, could lift the weight with the same lever!

Yet this is what the public are made in a great measure to believe by the statements we so frequently see of the extraordinary performances of engines. It must be clear then, that the limit to the power of any locomotive engine to propel trains *is the adhesion of its driving wheels to the rails*, which adhesion is at all times, and under all circumstances, *in proportion to the weight on the driving wheels;* and although this adhesion is not the same (in amount) under all circumstances, varying as it is well known, with the condition of the rails, as effected by the state of the weather, &c.; yet it is *always the same with all engines under the same circumstances;* hence the relative effective power of any two engines—power to propel trains—must be strictly *in proportion to the whole weight on the respective driving wheels of each;* which will be seen to correspond with the result of the trial.

I give you the statement as made at the time, officially, to the President of the Corporation, for the information of the Board of Directors.

* This is not strictly correct, vertical tubular boilers are used on engines in Maryland to a considerable extent, and various forms have been adopted in England for the boilers of locomotives on both common and rail roads. Com. Pub.

Engineers' Office, Western Rail Road,
Springfield, August 24th, 1840.

Thomas B. Wales, Esq., President W. R. R. Corporation.

Dear Sir,—In accordance with the leave granted to Mr. Richard Imly, by vote of the Board of Directors of the 11th of April last, to place an engine on this road for trial, he arrived at our depot here on Thursday afternoon with a locomotive engine, constructed by Mr. William Norris, of Philadelphia; the engine is of the largest class: on eight wheels, four being drivers of four feet diameter; her cylinders are twelve and a half inches diameter, and length of stroke twenty inches.

It was arranged that the trial should be made next morning with this engine, to ascertain what load she could draw up the plane on this road, next to our depot here; (it being the maximum grade east of the Connecticut river) and also to see if one of the corporation engines could draw up the same plane an equal load in proportion to the weight on its drivers.

The foot of this plane intersects the level through the depot yard about two hundred feet from the passenger house, and rising at the rate of 60 feet per mile for 8,200 feet, then at the rate of 66 feet per mile for 2000 feet, then at the rate of 46 feet per mile for 700 feet, and thence to the top at the rate of 60 feet per mile, is two and forty-four hundredths miles in length.

The engines being ready with full tenders of wood and water, and steam up, were brought to the platform scales to be weighed; the object being not only to ascertain the whole weight of each engine, but what portion of the whole weight is brought to bear on the driving wheels of each; it is known too, that when the steam is applied to give motion to the engine the effect is to alter the distribution of the weight of the engine between the forward and driving wheels, relieving the former of a portion of their weight and placing it on the latter. Measures were taken in the weighing to ascertain the extent of this change; this was done by placing each engine, first with the forward wheels on the platform scales; the tender, being attached to the engine, was chained to the track to prevent the advance of the engine when the steam was let upon the piston, that the effect might be exhibited by the scales; this effect was to relieve the forward wheels of a part of their weight.

The driving wheels were next placed on the platform, the tender chained to the track as before, and the steam applied; the effect was to increase the weight on the driving wheels.

The results of the weighing are as follows:—

Engine "America," built by Norris.

Weight on driving wheels,	- - -	17,550 lbs.
Do. forward wheels,	- - -	11,590
Total weight of engine	-	29,140 lbs.

Weight of Tender, (eight wheeled) wood and water.

Weight on forward truck,	- - -	13,050 lbs.
Do. hind truck,	- - - -	12,870
Total weight of tender	-	25,920 lbs.

Weighing under Pressure of Steam.

Weight on forward wheels without steam,		11,590 lbs.
Do. do. do. with steam,	-	9,650
Difference	- - -	1,940
Weight on driving wheels without steam,		18,620
Do. do. do. with steam,	-	20,010
Difference	- - -	1,390

After this engine had performed her trip, she was placed again on the platform scales, it having been observed that she worked under higher pressure of steam up the plane than when on the platform at the first weighing; at this weighing the result was as follows:—

Weight on the driving wheels without steam,	19,220 lbs.
Do. do. do. do. with steam,	21,070
Difference - - -	1,850

It will be seen that these several weighings differ in their results; this may be attributed, in part, (in the cases where the weights of the same parts of the engine differ when weighed *without* the action of steam) to a different state of the water in the boiler, and to the fact that at the first weighing of the driving wheels the engineer and fireman were both off the foot board; but I am inclined to believe from the very great difference between the first and last weighing, which last was made with great care, that there must have been some error in reading off the first weight.

The difference in the weights under the pressure of steam may be attributed to the different positions of the cranks at the time of weighing, since the effect would vary from a maximum to nothing, depending upon their position.

Taking the weights, however, as they were recorded.

The first weight of the drivers without steam, was	17,550 lbs.
Add weight taken from forward wheels by first weighing with steam, - - - - - -	1,940
Total weight on drivers in operation by first weighing	19,490
Second Weighing.—On drivers with steam, -	20,010
Third Weighing.—On drivers with steam, -	21,070
	3)60,570
Mean weight on drivers in operation,	20,190

Engine "Suffolk," built at Lowell.

Weight on drivers, - - - - - -	16,150 lbs.
Do. on forward wheels, - - - - -	7,480
Total weight of engine - - -	23,630
Tender (four wheeled) wood and water - -	14,000

Weighing under Pressure of Steam.

Weight on drivers without steam, - - -	16,075 lbs.
Do. do. with steam, - - - -	17,150
Difference, - - - - -	1,075
Weight on forward wheels without steam, - -	7,480
Do. do. do. with steam, - -	5,700
Difference, - - - - -	1,780

First Weighing.

Weight on drivers without steam, - - -	16,150 lbs.
And weight taken from forward wheels, - -	1,780
Total weight on drivers in operation, first weighing,	17,930

Second Weighing.

Weight on drivers with steam, - - - -	17,150
	2)35,080
Mean weight on drivers in operation, - - -	17,540

The effective weight (weight on the drivers) of the "America," Norris' engine, is - - - -	20,190 lbs.
That of the "Suffolk," Lowell, is - - - -	17,540

Immediately after the weighing was completed, the "America" was attached to a train, consisting of twenty-seven cars, and started on the level at the foot of the plane within about 400 feet of the plane, commenced ascending with a velocity of about seven miles per hour; ascended about one mile, gradually diminishing the velocity until the adhesion of the drivers being overcome, the wheels slipped and the train stopped, not being able to proceed further up the plane with the load; returned with the train down the plane to the starting station. Mr. Imly was requested to take such load as he thought the engine would take up the plane at a speed not less than six miles per hour; he detached six cars; started again with twenty-one cars, gross weight 259,698 lbs.; with this load she ascended the plane, with steadiness to the top in twenty-six minutes, being at the rate of 5.63 miles per hour.

The engine returned again, with this load, to the starting place, when the "Suffolk" (Lowell) was attached to the same train, leaving off four cars, taking seventeen cars, gross weight 198,042 lbs.; with this load she ascended the plane to the top in $14\frac{3}{4}$ minutes, being at the rate of 9.92 miles per hour.

It was supposed when this trial was made that the train would give a load to this engine equal to that taken by the "America," in proportion to their effective weights; but it was found, after weighing the cars, that the load was deficient.

The "Suffolk" was again attached to the train with nineteen cars; gross weight 234,218 lbs.; with this load she ascended the plane to its top in $21\frac{1}{2}$ minutes, being at the rate of 6.8 miles per hour.

The whole load of the "America's" train, Tender included, was

Tender - - - -	25,920 lbs.
21 cars - - - -	259,698
Total - -	285,618

That of the "Suffolk's" train, Tender included, was

Tender - - - -	14,000
19 cars - - - -	234,218
Total - -	248,218

Effective weight of the "America,"	20,190
Do. do. do. "Suffolk,"	17,540

Then $\frac{17{,}540 \times 285{,}618}{2{,}190} = 248{,}129$ lbs., the load the "Suffolk" should have taken; she did take 248,218 lbs., thus showing that the effect produced by each engine, except in speed, was as it should be, *equal.*

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The greater speed of the "Suffolk" is most probably due to the greater diameter of her driving wheels; as the velocity of both trains was such—being small—the difference between them may not have materially effected the resistance.

The engine "Suffolk" is on four wheels, two of which are drivers, four and a half feet diameter. Cylinder twelve inches in diameter and eighteen inches stroke. Pressure of steam in the boiler, ninety pounds. Pressure of steam in the boiler of the "America," one hundred and thirty pounds.

Architecture.

Street Architecture.

Although the means afforded in this description of building for producing architectural effect are greatly circumscribed by the want of room and distant views, yet there are other considerations connected with it which render the subject one of decided importance:—the beautiful suburban villa—the rural and romantic cottage, may, indeed, ennoble and delight the mind of the spectator far more than the most perfect specimen of street architecture; but where *one* sees the villa or the cottage, a *thousand* see the city building; and a thousand minds are in some degree humanized and elevated, however, unconsciously, by its beauties.

Various plans have been resorted to in European cities to improve street architecture by legislative enactments, but with little success. Petersburgh, for example, is all built from designs submitted to, and approved by the government, with the exception of a single street; and that, in 1813, was the only one in the city, (as we are told by Mr. Louden) in which there are varied elevations, and, as the consequence, the only lively and agreeable portion of the town; the rest being a tiresome repetition of similar forms.

The new part of Edinburgh is built on a still more restricted plan —all the street elevations are furnished by one architect, and no builder is permitted to depart a fraction from the prescribed plan without the special sanction of the court; "hence (says the excellent writer just quoted) "it is one of the tamest congregations of buildings in Europe, and were it not for the external views of the old town on one side, and the Frith of Forth on the other, the new town of Edinburgh would be as dull as Berlin." This monotony is, however, counterbalanced by the magnificence of the surrounding scenery, the beautiful situation and grouping of the city, its cleanliness, and the substantial character of its

architecture,—a combination of qualities which render Edinburgh one of the loveliest and most romantic spots in the world.

Other European cities have similar, though modified restrictions on their street architecture, but seldom with a desirable effect;—the perfection of this description of building would be, not to have two elevations alike in any one street; as a repetition of similar forms, beyond what may be required for symmetry, always results in a fatiguing monotony.

The grouping of several houses so as to present the appearance of one extensive establishment, has, when tastefully designed, a better effect than almost any other description of city architecture, and it is certainly to be regretted that so few attempts have yet been made to embellish our streets by adopting a method at once so simple, economical, and effective. This plan has been successfully pursued in European cities to a considerable extent; in London especially it presents some of the most attractive specimens of city architecture ever executed.

An expression of unity may thus be imparted to a row of houses without interfering at all with the idea of their being separate dwellings; all that is required is to advance and elevate the centre and corner houses beyond and above the rest, and to proportion the various parts to the magnitude and importance of the entire group. Such a composition, no matter how poor and plain its individual features may be, will always awaken agreeable emotions of taste;—it looks like a finished work; the spectator realizes that nothing can be added to, nor taken from it, without destroying its oneness; and even though it may be wanting in the higher graces of art, it possesses qualities on which the mind may dwell with pleasure.

T. U. W.

Franklin Institute.

Annual Meeting.

The annual meeting of the Institute was held at their Hall, January 21st, 1841. Thomas Fletcher, Vice President, in the chair; George W. Smith, Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

Donations were received from The Zoological Society of London; The Society of Arts at London; The Royal Geographical Society of London; Professor M. Faraday, London; Petty Vaughan, Esq., London; Messrs. Marsh, Capen, Lyon, and Webb, of Boston; Thomas Bakewell, of Pittsburgh; Ohio Mechanics' Institute, Cincinnati; Geo.

Merrick, Esq., New Orleans; William A. Burt, Mount Vernon, Michigan; John Stewart, Esq., of Tennessee; James Herron, of Maryland; C. A. Woolsay, President of the Midlothian Coal Company, Virginia; Messrs. Frederick Fraley; M. W. Baldwin, Henry S. Tanner, J. Lyons, John H. Cresson, John Gest, Edwin Bishop, Alfred C. Jones, Isaac Hays, M. D., G. Emerson, M. D.; The American Philosophical Society; The Lehigh Navigation Company; The Legislature of the State of Pennsylvania; Professors Henry D. Rogers, and John F. Frazer, of Philadelphia.

The Actuary laid on the tables the periodicals received in exchange for the Journal.

The annual report of the Board of Managers, accompanied by the reports of the Treasurer and the several Committees, were read, accepted, and referred to the Committee on Publications.

On motion it was

Resolved, That the report of the Board of Managers be referred to a Select Committee of fifteen, who shall, in conjunction with the Committee of the Board, consult and report which measure should be taken to advance the interests of the Institute, and report at a special meeting, to be called by them.

The following gentlemen were named as the Committee.

Joseph Warner,	William B. Fling,
David S. Brown,	Richard Price,
Robert Peirsal,	Thomas Scattergood,
Paul W. Newhall,	Townsend Sharpless,
George M. Justice,	Samuel R. Brick,
John K. Kane,	Thomas S. Stewart,
John P. Wetherill,	Findley Highlands,

Thomas U. Walter.

Mr. Findley Highlands, from the Committee of Tellers of the annual election for officers and managers of the Institute for the ensuing year, (appointed at the preparatory meeting, this day), presented their report of the result of the election; when the Vice President declared the following gentlemen duly elected.

James Ronaldson, President.
Isaiah Lukens, } Vice Presidents.
Thomas Fletcher, }
Isaac B. Garrigues, Recording Secretary.
Alexander Dallas Bache, Corres. Secretary.
Frederick Fraley, Treasurer.

MANAGERS.

Samuel V. Merrick,	Charles B. Trego,
Abraham Miller,	Henry Troth,
John Struthers,	John S. Warner,
Matthias W. Baldwin,	William Hart Carr,
Isaac Hays,	Henry D. Rogers,
J. Henry Bulkley,	John Gilder,
John Agnew,	Ambrose W. Thompson,
John Wiegand,	George Taber,
Samuel Hufty,	Thomas U. Walter,
John C. Cresson,	John H. Towne,
Andrew M. Eastwick,	James Hutchinson,
Isaac P. Morris,	Edwin Greble.

Extract from the minutes.

THOMAS FLETCHER, Vice President.

GEORGE W. SMITH, Recording Secretary, P. T.

Seventeenth Annual Report of the Board of Managers of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts.

The managers of the Franklin Institute present their seventeenth annual report. The year which has just closed has been marked with an unusual degree of activity by our Society, in all the departments of science and the useful arts, to which the attention of the institution is directed by the charter. The particular details of the labours of the several committees of the board of managers, and of the exertions of the professors, have been presented to the Institute in the usual quarterly reports. It may not, however, be uninteresting to the members to make, at this time, a brief summary of the transactions of the year, nor will it, we trust, prove unprofitable to the institution, if we thereby ascertain what is still needed to enable us fully to realize the plans of our original establishment. The great department of the Institute is that of instruction; to the ends of this one all others are subservient, and our usefulness must, in a great degree, be advanced or restricted by the attention to, and success of, our various courses of teaching. So far as the labours of devoted and able instructors will fortify us in this respect, and so far as various and interesting knowledge presented to the classes may have a tendency to promote our success, we may congratulate ourselves in possessing them all. The series of lectures for this winter, embrace complete courses on general chemistry, natural philosophy, and mechanics, application of chemistry to arts and manufactures, geology

and architecture, and in addition to which, we have already had one volunteer lecture on architecture, by a distinguished architect of Baltimore, Robert Cary Long, Esq., in whom the Institute recognize a zealous as well as a highly gifted friend; other gentlemen of ability have likewise promised to lecture on various subjects of interest and utility, by which five evenings in each week will be occupied in our lecture room. It has already been announced that in consequence of the much regretted resignation of Professor John K. Mitchell, a vacancy occurred in our chair of general chemistry, which had been filled by the election of John F. Frazer, Esq. While the distinguished ability of Professor Mitchell made it a difficult task for the Board to select a successor who could advantageously fill the chair which he had vacated, the Board feels that in the talents, zeal, and energy of Professor Frazer, they have met with a gentleman every way worthy to succeed Professor Mitchell, and the general approving voice of the large class of the present session fully confirms the propriety of his selection for the chair. In addition to the regular duties of the chemical chair, Professor Frazer is furnishing the Institute with a full course of lectures on geology, a subject which, in its intimate connections with many important departments of human industry, enjoys, at the present time, a large share of public attention. Professors Cresson and Booth continue in their respective chairs of natural philosophy and mechanics, and of chemistry applied to arts and manufactures, and in the new and valuable illustrations which they are daily presenting to the members, of the discoveries in science, which tend to facilitate various processes in the arts, and to disseminate more correct knowledge of the principles upon which the arts depend. The Institute is steadily progressing under their instructions in forming a body of well trained practical men, fully competent to undertake the construction of the most ponderous machines, or to introduce into our manufactories and work shops, the latest improvements. A course on theoretical and practical architecture has been authorized by the Committee on Instruction, and Thomas U. Walter, Esq. elected to the Professorship in that department. Mr. Walter has just closed his series of lectures for the present season, and the Board feel that in bringing a mind like his, clothed with all the knowledge and experience which places the resources of that art, both ancient and modern, tributary to the illustration of his subject, they have not only contributed to the advancement of the class in a proper appreciation of the beautiful in building, but likewise connected that knowledge with the expressive and high wrought poetry with which the grand but crumbling monuments of skill have been commemorated. The drawing school continues under the charge of Mr. William Mason, assisted

by Mr. S. Rufus Mason, and there are sixty-three pupils in attendance. These pupils have the privilege of attending the lectures of the Institute, and in addition to them, two hundred and sixty-two minors' tickets have been issued, forming a class of three hundred and twenty-five, who are receiving the benefits of our extended courses, at the extremely low price of one cent per lecture. The number of ladies' tickets issued this year have been only sixty-one, which is a subject of regret to the Board, as the influence of their presence and example in the class room cannot but be of great advantage in promoting order and attention.

The very interesting exhibition of American manufactures, held by the Institute in October last, and of which a detailed report has been published, and extensively circulated, fully sustained the character of our country for ability to produce all that has been found necessary for our comfort and ornament. The medals and certificates then awarded have been nearly all delivered, and the value which our manufacturers set upon these tokens of the approbation of our institution, is the best evidence we can furnish of its universally acknowledged usefulness. The suite of rooms in the third story of the hall has been fitted up for the reception of the cabinets of models and of specimens of arts and manufactures, and the access to these collections made easy by a flight of stairs leading from the reading room. Our collection of models, placed under such favourable circumstances, and superintended by a zealous and faithful Committee, is rapidly increasing, and will soon fill the space allotted to it. The cases for the reception of the collection in arts and manufactures, are all prepared, and some valuable specimens have already been deposited. Almost every member of the Institute can readily contribute something from his own work-shop, manufactory, or store, to enlarge the deposits already made, and when the interest and value which such a collection must have in the minds of those who are participating in the benefits of the institution, are taken into view, we feel assured that the donations of our brethren will be liberal. The cabinet of minerals has been regularly arranged by the efficient Committee in charge of it, and already contains a great number of rare and valuable specimens. These are daily augmenting by the donations of our friends in all quarters of the country, and our collection is much frequented by the members, who are gradually acquiring a taste for the beautiful sciences of geology and mineralogy.

The library is receiving gradual additions; it now contains about two thousand five hundred and twenty-two volumes, and during the year, one hundred and fifty-eight volumes have been added, by donations, exchanges for the Journal, and purchase. It has been mat-

ter of regret to the Board that the limited funds of the institution will not permit more liberal appropriations for the purchase of books. The attempt, on the part of the Institute, to establish a Mechanics' Exchange, with fixed hours for the assembling of the mechanics and manufacturers, for the transaction of their regular business, has failed; but it is believed that many of the advantages anticipated from it are realized, in informal meetings which occur throughout the day and evening, in the reading room. The meetings held monthly for conversation on scientific and mechanical subjects, are continued on the same plan as those held last winter, and they continue to be well attended.

Although the Journal of the Institute has met with a considerable share of patronage, the Committee in charge of its publication have found that it was barely defraying the expenses of its editorship and printing. Anxious, however, to secure such a periodical to our country, they have recently made arrangements with several gentlemen of distinguished ability, to furnish contributions regularly for its pages. The talent thus enlisted in its support, and the determination of the Committee to publish it in a larger type, and make it more generally interesting, will, it is hoped, be met by the members of the Institute and the public, by a liberal support of the work. The number of subscribers from among the members of the Institute is quite too small, and it should be a matter of pride with them to place the periodical of their own institution on a ground at least as favourable for its continued publication as seems to be afforded to works of a similar character, coming from the press of our neighbouring cities. The labours of the Committee on Science and Arts, have, as heretofore, been very great. Fifty-nine new inventions, or claims to such, have been presented for their examination, and upon those entitled to favour, as either containing new adaptations of principles or new and valuable combinations, the Scott's legacy medal and premium, or favourable reports have been awarded. During the year, the medal and premium above alluded to, have been deemed due to ten inventors or to ingenious men for improvements, and after making the necessary proofs of originality, they have been awarded and delivered. Under new arrangements made by the Committee on Meteorology, the number of observations on atmospheric phenomena have been increasing.

At present, reports are now received regularly from thirty counties in this State, and also from highly respectable and zealous observers in other States. Regular tables of the mean state of the observations made in our own Commonwealth, are published monthly in the Jour-

nal, and form valuable tables for comparison with those made and recorded elsewhere.

Within the year, the following gentlemen have become Life Members of the Institute.

Messrs. Thomas Mellor, James Christy, Thomas Firth, Isaac S. Ashton, Michael Magee, William H. Moore, Henry J. Biddle, William J. A. Birkey, Owen Jones, William C. Betts, Joseph Woods, Joseph W. Busby, George W. Toland, John Agnew, Lewis Taws, Levi Morris, G. D. Rosengarten, Andrew Young, Thomas D. Lee, William M. Hartshorne, Joseph Hartshorne, M. D., and three hundred and sixty-two new members have been elected.

As nearly as can be ascertained, about fifteen deaths have occurred, and sixty-four have resigned; the actual number of members, both life and annually contributing, may be set down at two thousand. For the state of the funds of the institution, as connected with its general expenditures, publication of the Journal, sinking fund and loans for the hall, and the purchase of the Masonic Hall property, the Board refer to the accompanying reports and statements, from the Treasurer and Committees.

John C. Cresson, *Chairman.*

William Hamilton, *Actuary.*

Philadelphia, January 20th, 1841.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Wm. A. Burt's *Solar Compass.*

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Solar Compass, invented by Wm. A. Burt, of Mount Vernon, Michigan: Report,

That they have examined the instrument of Mr. Burt, which is a modification of that for which he received the Scott's Medal in 1835. The instrument in its principal parts has been already described. The improvements introduced by its inventor tend to render the instrument more simple in its use, and more permanent in its adjustments. The method is susceptible of any degree of accuracy desired. In the model submitted to the committee, which was the workmanship of Mr. Wm. J. Young, the principle of reversion is applied throughout, and serves to remove all danger of index error in any of its adjustments. In a clear day, in a latitude not yet determined, this instrument, without the use of a telescope, is adequate to the determination of latitude within two minutes, and differences of latitude perhaps to one minute. The line of sight being brought in the direction of an object, and the instrument adjusted for the sun's actual declination,

and the latitude of the place, (determined by a previous culmination of the sun with this instrument,) the exact azimuth from the true north or south is read, and the reading of the compass is of no further use than to serve as a check to the comparative azimuths determined astronomically, and also to furnish a permanent record of the variation of the compass for the particular station. The instrument is simple in its construction and use—requires, when properly understood, no inconvenient expenditure of time—and in districts abounding in magnetic iron ore, is almost indispensable. It seems to be a very important improvement over the ordinary surveyor's compass, and deserving of great commendation. Above all, the committee cannot omit to mention the exceeding value of surveys made with this instrument, in fixing the variation of the compass, and thus furnishing besides the particular result, viz. the boundary and contents of the field or plot, the permanent record also of the magnetic variation. When such results are increased, and the instrument more generally used, which its intrinsic merit fully warrants, a most important addition will be made to the stock of our knowledge on this highly useful element, viz., the magnetic declination and its periodical changes in a great variety of localities.

By order of the Committee.

William Hamilton, *Actuary.*

Philadelphia, Dec. 14, 1840.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1839.

With Remarks and Exemplifications by the Editor.

1. For an improved *Frame Work Knitting Machine;* Richard Walker, Portsmouth, New Hampshire, December 5.

Those who have ever seen a stocking frame must be aware of its great complexity, or rather of the great number of pieces which go to make up the instrument. In the present instance an attempt is made, and we think not without success, to give to the machine greater simplicity without sacrificing any of its good qualities. Although we have had occasion to make a thorough examination of this machine in all its parts, we cannot pretend to describe it in less space than the eight pages occupied in the record of it, accompanied by the different figures in the drawings.

2. For improvements in *Fire Arms;* Benjamin F. Smith, South Hadley, Hampshire county, Massachusetts, December 5.

"The principal feature in which this gun varies from those in com-

mon use, consists in igniting the charge within the cartridge with which the gun is loaded."

The cartridges are formed in the following manner. The outer casing is of paper, formed to suit the caliber of the gun; within this is placed the proper quantity of powder, and next to the powder is placed the torpedo, or wad, into the centre of the lower end of which is inserted a small quantity of percussion powder, which ignites by being pierced with the point of a needle. This needle is to be forced in by the action of the lock, through the centre of the charge of powder, and into the wad in front of it containing the percussion powder, and the discharge is to be thus made.

The whole instrument is described with considerable minuteness, and the patentee says, "I do not claim separately the needle for igniting the charge, or the spur for holding the cartridge, but I do claim the combination of the needle and tumbler, and the combination of the spur, horizontal lever and tumbler as described; and the peculiar construction of the hand lever by which it operates upon the tumbler and spring, and the horizontal lever at the same time, for the purpose of removing the needle and spur, so as to admit the cartridge and cocking the gun at the same operation."

We are aware that the foregoing claim will not explain the particular construction of the parts; but we think that enough has been said to lead to the conclusion that however ingeniously the parts may have been contrived, there is but little probability of this gun being brought into general use.

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3. For improvements in *Railway Bars;* Edward Tilghman, Civil Engineer, city of Philadelphia, December 5.

"The nature of my improvement is in the so forming the bar that there shall be a reduction of the height usually given to the T rail, between its head, and the base on which it rests, thereby diminishing the leverage of the rail, whilst its strength and its capability of being firmly secured to the cross tie are provided for by the addition of a rib directly under the centre of the base, which may be made plain, trapezoidical, or with a lower web, as practiced in many English edge rails. To fasten this rail I insert the lower rib thereof in gains cut in the cross ties, at the lower part of which gains there is a suitable recess for one side of the lower web; the rail is to be inserted in this gain and wedged securely in its place, where it will be supported conjointly upon the ordinary base, and upon the under part of the lower web."

The claim is to "the addition of the under rib to the T rail, below its base, or seat, in the manner and for the purpose set forth. I do not claim the inserting the lower part of the rail within the thickness of the cross tie, this having been before done, but I do claim the employment of a chair inserted and used in the manner set forth, for the purpose of joining and firmly securing the ends of the railway bars."

The chair referred to consists of a flat plate which is received into two notches, one in the end of each bar, immediately under its base;

the two when put together constituting a mortise that receives said chair, or plate, which is affixed to the cross-ties by bolts or spikes.

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4. For a machine for *Separating Corroded and Uncorroded Lead;* Edward Clark, Saugerties, Ulster county, New York, December 5.

The semi-corroded lead is to be passed between rollers, furnished with grooves, or checkered, so that the uncorroded lead will be stretched, or bended, and again straightened, and thus the corroded parts be separated from that which remains metallic.

The machine is to be put in motion so that each individual roller will turn inward upon its fellow, and downward; and the lead is to pass through between these rollers in a crimped state to the next series, and so on, when it falls upon an endless apron, and is carried away to be again subjected to the corroding process. The claim is to the combination of plain and grooved rollers, and also the revolving apron, brushes, and scrapers, &c.

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5. For a *Spark Arrester;* Nicholas Turbutt, Fredericktown, Frederick county, Maryland, December 7.

Not finding in this instrument any thing which appears likely to overcome the difficulties which have condemned to banishment, most of the members of the family of spark arresters, we shall not take the trouble to describe it, nor will it be of any use to insert the claim.

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6. For a *Cotton Press;* John Price, Nashville, Davidson county, Tennessee, December 7.

The claim made by the patentee is to "the manner in which I have combined the power of the screw, and the levers. That is to say, I claim the first pressing by means of the screw, and then securing the upper follower by means of the compression blocks, and the completing of the operation of pressing by the two leavers acting upon the lower follower, in the manner described, said levers being drawn down by any adequate power; I claim the particular combination of the swivel and its appendages, for raising the lever."

The pressing screw is placed vertically, and descends by turning a lever, or cross head, as in many other presses for cotton. When this screw has compressed the cotton to the extent of its capacity, a follower beneath the cotton bale, is forced up by means of two levers which have their fulcra in the cheeks of the press, their short arms under the follower, and their long ends extending upwards at an angle say of 40° on each side; these by being drawn down force the lower follower up, and give additional pressure to the bale.

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7. For a *Franklin Cooking Stove;* Abner R. King, Parma, Monroe county, New York, December 12.

"The nature of my improvement consists in a new and useful combination of a swinging damper in the back plate of a common Franklin stove." The manner in which the patentee carries out his design of adding a cooking apparatus to the back part of, or behind, the ordi-

nary Franklin stove, occupies several pages in description, referring to ten figures in the drawing. The claim is made by letters of reference to the respective parts, and need not be given. To us the arrangement appears to be such as will afford little advantage in cooking, whilst the stove itself will be an inconvenient article. The idea of combining an open Franklin with a cooking stove is not new, it has been often attempted, but has never gone into extensive use.

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8. For a *Fracture Apparatus;* Horson M. Allaben, Middletown, Delaware county, New York, December 12.

The claim is to "the combination of the splint, foot-board, and extension roller, with the fracture bed, or chair." This apparatus consists of a bed, or couch, on which the patient is to lie, and which is furnished with the devices rendered necessary, or convenient, by his position and state; to this is also appended the apparatus required for cradling, and giving extension to, a fractured limb. The description occupies ten large pages, which we shall not attempt to epitomize. Such an instrument, if it offers any advantages, we always think ought to be given to the public, especially if they are devised by those in the practice of the healing art. Perhaps we are wrong in this conclusion, and we are willing to be thought so to be.

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9. For an improvement on *Bedsteads;* Benijah Bosworth, Fayette county, Kentucky, December 14.

This patent is for the mode of fastening the posts and rails together, and of tightening the sacking bottom. The rails are to be round, and have round tenons on their ends; the sacking bottom is to be attached to them by wooden pins and eyelet holes; and on the part which will become the under part of each rail there are to be projecting pins inserted, three or four inches from each end, making in all eight such pins, an inch in diameter and two in length, with a neck turned near their outer end. Round these pins cords are to pass like those used for tightening a frame saw, and the cords are to be twisted by means of a stick of wood, in the same manner, and thus the sacking is to be tightened.

The claim is to "the method herein described of tightening the sacking bottoms of bedsteads by means of the rope attached to the pins projecting from the under sides of the rails, and twisted by a stick."

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10. For a *Visceral Supporter;* Benjamin Reynolds, Camden, South Carolina, December 14.

The patentee calls this the *Gerenteron, or Visceral Supporter*, and has given a description, and dissertation extending through fifteen pages of record. His claims are the following.

"1st. Constructing the back pad plate a little raised on each side of the centre so as to form a recess on the under side that the spine may be safely lodged therein, in combination with the vertical hinge in the centre, permitting each side to fold down so as readily to adapt itself on each side of the spine, to any shape of the back.

"2nd. The combination of the hip springs, constructed and arranged as described, with the front and back pad, the whole being arranged and operating in the manner set forth.

"3rd. The mode of adjusting the hip springs on the front pads, as described.

"4th. The mode of adjusting the front pads so as to adapt them to any sized abdomen.

"5th. The construction of the pad for supporting the perineum with an elliptic spring in the centre, as described."

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11. For *Bedstead and other frame work fastenings;* Joseph Rodefer, Cincinnati, Ohio, December 18.

The claim will afford a general idea of the bedstead fastening referred to, and which is called an *improvement.*

"I not claim to be the inventor of the mode of fastening the rails of bedsteads into the posts by means of a bolt with the segment of a screw on its end projecting from the former, and secured into a mortise in the latter, this having, as I am informed, been previously patented. But what I do claim is the mode herein described, that is to say, having the segment of the screw on the end of one rail embrace a screw on a projection from the end of the screw bolt attached to the adjoining rail, as herein described."

New modes of fastening bedsteads are frequently brought forward, and those who devise them no doubt attach great importance to them; they hope, at least, that others will be induced to do so. After examining through the whole catalogue of fastenings we have not met with one which we would prefer to the old fashioned bedstead screw, when well made, so as to fit the nuts indiscriminately. When the saving of twenty-five cents in a set of eight screws is made an object, they will be inferior in quality, with bad threads, and irregular in size, and this is the main source of objection to them; but if we wanted bedsteads we would take care to have them furnished with good screws and nuts of the common kind.

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12. For an improved *Silk Loom;* Cornelius Bergen, city of Brooklyn, New York, December 18.

Although the loom as improved does not vary, in general, from others, the description of it is given at much length in the specification, which concludes with the following claims. "1st. The employment of the cams with double sections in connection with the arrangement of levers and springs for the purpose of driving the shuttles, as described. 2nd. The making of the batten is two parts for two or more rows or tiers of shuttles, and, in combination therewith, the manner of throwing the shuttles by means of three drivers, one acting as the main driver, by the action of which the other two are driven, as described. 3rd. The arrangement of levers, springs, and cams, for raising and lowering the shuttles, in combination with the batten; the cams to be dispensed with when working by hand, as described."

13. For a *Cheese Press;* William W. Townsend, Shoreham, Vermont, December 18.

The claim is to "the method of applying the weight to the press, by having a cord and a loop, ring, or something equivalent thereto, attached to the weight; the former for the purpose of winding up a weight by passing over a pulley, or pulleys, and the latter to attach the weight to the lever; the whole being constructed substantially as set forth;" which construction consists in the particular manner in which the parts are arranged, which possesses so little of the attribute of invention as to render it difficult to find for what the patent was granted, and, therefore, very easy to avoid interferance without evading or invading any vested right.

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14. For a *Burner for Burning Pine Knots;* John Price, Nashville, Tennessee, December 18.

This burner is made much like the common old fashioned iron candlestick, but large, so as to hold a pine knot: and it is pierced with holes below the holding part, to give the requisite current of air. A funnel is to be placed over it, to carry off the smoke.

The claim is to "the use of a vertical tube, or other suitably formed body, perforated with holes for the admission of air to the burning pine knot, light wood, or other analogous material, which is to be placed therein, as herein set forth, and the burner set under a funnel and smoke pipe, or other analogous fixture."

A contrivance for burning pine knots, or light wood, may appear to be a trifling affair to those who live in the region of oil, tallow, and spermaceti; but the millions, whose only artificial light is "*light* wood," in the west, and in the south, may think otherwise, and although there is no great display of mechanical talent in the device referred to, it may make up in utility what it lacks in invention, and furnish a convenient mode of effecting that which is now effected in a very rude and inconvenient way.

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15. For a *Spring Bolt Shutter Fastening;* George Smith, city of Philadelphia, December 18.

The whole specification of this patent is contained in a small compass, and is as follows:

"The nature of my invention consists in attaching to the plate on which the bolt is stapled, a guard or lock for a key, which operates on a spring similar to a spring lock. The spring is set on the under side of the bolt plate, with a catch fixed to the spring; when the bolt is shoved home, the catch springs up into a corresponding notch cut in the bolt, so that it cannot be unbolted without a key to press the spring catch out of the notch in the bolt. The bolt in other respects has the usual plate and staples. The above particulars will enable any one skilled in the art, to make and use my invention.—What I claim as my invention, and desire to secure by letters patent, is the employment of the spring catch opened by a key, acting on its sloped face,

and attached to the back of the bolt plate, in combination with the bolt, herein described."

We apprehend that the necessity for using a key for a shutter fastening will be a fatal objection to its general adoption, whatever might be its merits on other points.

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16. For a *Smut Machine;* Samuel W. Foster, Scio, Washtenaw county, Michigan, December 21.

"The nature of my invention consists in constructing a floor of the cylinder with a rim or coller, around the shaft, for the purpose of preventing the grain from passing out between the shaft and cylinder; and in combination therewith, adapting a disk to the aforesaid rim, or collar, by countersinking it, by which means a trough or channel is formed for the grain, in which it is retained and operated upon with more effect than if the bottom of the cylinder were a perfect plane."

The grain is to be fed in on the upper side of a vertical cylinder, against the rough and preforated sides of which it is thrown by revolving arms, and beneath them it is rubbed between projecting points on the bottom of the cylinder and revolving rubbers. The difference between this and some other smut machines is small, and the claims are limited to certain minor arrangements, the principal of which are designated in the above extract stating the nature of the invention.

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17. For *Manufacturing Needles;* Abel Morrall, Great Britain, December 21.

"My improvement in making or manufacturing needles, consists in an improved mode of clearing and finishing the eyes of sewing needles, by removing any burs, feathers, or sharp edges, from the insides of the eyes, of such needles, which, without being so cleared and finished would be subject to cut the thread in the operation of sewing." "The invention consists in the spitting or stringing of needles upon a steel or other wire, or any suitable substance which may be passed through the eyes thereof, and which either by means of edges or teeth formed thereon, or by the application of some grinding or polishing material thereto, shall remove the asperities from said eyes and render them perfectly smooth, by giving to said needles, while so strung, a shaking or reciprocating motion, as set forth."

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18. For a *Self Acting Safety Valve;* John P. Bakewell, city of Pittsburgh, Pennsylvania, December 21.

"The nature of my invention consists in a mode or method of fastening and securing the standard, or upright, which is connected with the fulcrum, pivot, or turning point, of the beam, or lever, of a common safety valve, in such a manner as that the heavier the weight may be which is placed upon the opposite, or long arm of the beam, for the purpose of keeping the valve closed, the more certain and effectual shall be the operation of the apparatus in opening the valve whenever the boiler, or generators, shall have been heated to such a degree of temperature as may be considered dangerous, or liable to become so."

A fusible metallic alloy is to be used in this apparatus, by the melting of which at a given temperature it is intended to insure the operation of the apparatus; the use of this metallic alloy is not claimed, "or the combination of a vertical cord, or stem, therewith,—or their further combination with the lever or beam of the safety valve, as these are not new, and are claimed by Mr. Oliver Evans, as his invention." But the patentee claims "the mode in which he has arranged the several parts of the apparatus; that is to say, the attachment or connexion of a rod, or stem, to the end of the lever or beam of a safety valve, in such a way as that it shall be the fulcrum, pivot, or turning point of the beam as long as the alloy remains unfused. And the placing a standard or upright between the safety valve and the weighted end of the lever, to which the beam shall shift its fulcrum or pivot whenever the alloy shall become fused, or melted."

There is, it seems, considerable resemblance between the foregoing plan and that patented by Mr. Evans, but the two were considered in the office as sufficiently different to justify the grant of a patent in the present case; whether this question has been made one of legal investigation we are not informed, and prefer not in the present state of the question, to express any opinion of our own, without being authoritatively called upon so to do.

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19. For constructing *Portable Houses for Transportation;* Frederick S. Barnard, city of Philadelphia, December 21.

The point claimed is "the completing the sides, ends, floors, roofs, &c., separately, and completely finished, to be put together, as described."

The particular manner of connecting the parts as given by the patentee need not be detailed; and we suppose that any good carpenter would find it easy to put his work together in modes of his own devising, without interfering with any vested right, if such there are which can be sustained. We are apprehensive also that it will rarely be found convenient to transport the parts of houses in such large masses as would be required on the proposed plan.

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20. For an improved *Wheel for Carriages;* Elisha Talles, city of Hartford, Connecticut, December 27.

The wheel is denominated a *Metallic Suspension Wheel;* and after describing it, the patentee says that he does "not claim the suspension principle, or the making any part of it of métal; or any thing in the shape of the spokes, or the securing them at each end by nuts; but I do claim as my invention and improvement, 1st. The rim of the wheel of the form and shape hereinbefore described. 2nd. The furnishing a metallic hub with a box, or boxing, which can be replaced when worn, and secured in its place, as described. 3rd. The sand valves in the manner and for the purpose described."

The rim of the wheel is so formed as to have a groove, or channel, around it, which is to receive wooden felloes, and these are to be sesured in their place by hoop tire, in the usual way. The hub is cast

with a perforation large enough to receive a metallic box, or boxes, for the axle to run in. The "sand valves" are washers, with rims, borne up by springs against each end of the hub, to prevent the entrance of dirt of any kind, and to keep in the oil.

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21. For *Dressing Paper Pulp;* Nathaniel Hebard, Dorchester, Norfolk county, Massachusetts, December 27.

The ordinary pulp dresser, consists of a plate of metal having numerous narrow slots cut along it, for straining the pulp. In cleansing these out when they become choaked, the openings are gradually widened, and the instrument injured. The object of this invention is so to construct this instrument as that the openings may be narrowed and widened at pleasure, and set to any degree of fineness. For this purpose, strips of metal, of equal widths, are attached to a frame by joint pins at one of their ends, and at the other by similar joint pins, to a sliding bar. When the strips stand at a right angle with the part of the frame to which they are jointed, they are at sufficient distance apart to clear them from all obstructing matter, and by means of the sliding bar to which they are jointed at the opposite end, they may be made to approach each other in any required degree. The claim is to this arrangement of the parts.

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22. For an improved *Rail Road Chair;* Britton M. Evans, city of Lancaster, Pennsylvania, December 27.

This chair is intended to obviate the necessity of wedging the Wigan rail. The chair is to be cast in two parts, one of its sides, or cheeks, being separate from the other, and being removed to put in the rail; when so placed, the loose cheek is driven in, and the rail thereby confined; the patentee says, "I would have it understood that I am aware that rail road chairs have been made with a movable jaw, and secured by means of wedges; I do not, therefore, claim that as my invention; but what I do claim as my invention, and desire to secure by letters patent, is the making of the movable jaw with a dovetail to fit into a corresponding slide in the chair, and secured by a pin, as described."

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23. For a *Socket for holding Tools;* Herrick Aikin, Franklin, Merrimack county, New Hampshire, December 27.

This socket varies but little from others that have been made for holding awls and other tools, and is in itself a subject of so little importance, excepting to the patentee, as not to require a particular description.

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24. For a *Cooking Stove;* George D. Boyce, West Wareham, Plymouth county, Massachusetts, December 27.

This stove is in the ordinary form of those having a fire chamber in front, with an oven in its rear, and boiler holes at top. The claim, therefore, is confined to certain special arrangements; such as to the

manner of arranging the flues and dampers; the dividing the fire chamber into two parts, so that the fire space may be limited when required; and to the manner of combining a pipe for carrying off the vapours, with a sliding smoke pipe.

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25. For a *Truss for a Bridge;* Herman Haupt, York, York county, Pennsylvania, December 27.

"The distinguishing feature of the proposed improvement, is that no counterbraces are used, and the ties are in both straight and curved bridges, perpendicular to the lower chord, the pieces being of the size and arrangement similar to that which is usual for lattice braces."

"What I claim as my invention is the construction of a lattice bridge without counter braces, but consisting simply of braces inclined at any proper angle, and ties which are perpendicular to the lower chord, the chords being either straight or curved."

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26. For an improvement in *Bee Hives;* William M. Hall, Wallingford, New Haven county, Connecticut, December 27.

The object of this invention is so to construct the hive as that it will discharge the worms and other filth that may infect it. To effect this, a double inclined plane is placed at the bottom of this hive, by means of which the discharge is to take place. There is to be an opening of about half an inch at the junction of these planes, through which the bees may enter, and the foreign matters will fall. The claim is to "the protecting base, made with inclined planes, substantially in the manner and for the purposes specified."

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27. For an improved *Spark Arrester;* Thomas Raeney, city of Philadelphia, December 28.

This spark arrester operates upon the same principle with that of Mr. Briscoe, the specification of which was published in vol. xxiv. p. 236, of the last series; but the improvement consists in greatly enlarging the space allowed for the escape of the draught, through inverted cones of wire gauze, or of perforated metal inserted in a cap plate forming the top of the chimney. Mr. Briscoe used but one inverted cone of this kind. The patentee says, that "in an apparatus of this kind I have used eight such perforated cones; the center cone at its upper or open end is eleven inches in diameter, and twenty-one inches deep to its angular point or apex, with seven surrounding cones, eight inches in diameter at their open ends, and thirteen to their angular points."

"I am aware that the top or covering of a cap, or hood, has been made of wire gauze, in the form of a single inverted cone or curved segment of a hollow sphere; but it is not possible with a single cone to obtain sufficient escape surface for the draft. I do not, therefore, claim the merely giving to the covering of such a cap the form of an inverted cone; but what I do claim, is the inserting of a number of such cones of perforated metal or wire gauze into suitable openings in the plate of metal which forms the covering, or top, of such a hood

or cap, for the purpose of giving sufficient surface for the passage of the draft through the perforations or meshes of such cones. I also claim, in combination with a number of cones arranged and perforated as described, the perforating of the upper sides of the hood, or cap, said perforations being surrounded by a rim retiring from said hood, or cap, and rising up above the upper surface of the top plate thereof, as set forth."

We have repeatedly heard favourable reports of the operation of this instrument, which has continued in use, and that is more than can be said of a number of others.

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28. For a *Blowing Apparatus for Furnaces, &c.;* Frederick R. Dimpfel, city of New York, December 28.

The blowing wheel in this apparatus resembles that in ordinary use, but "between the wind wheel and the outer case, a space is left which may be denominated the air chamber. In this space, as also in and around the wind wheel generally, the air will become condensed by the rapid motion of the wheel, and not being able to escape in consequence of the closure between the collar and the outer case, as described, it may be made to exert a pressure of several pounds to the square inch, by regulating the escape opening."

The claims are to "the enclosing of the vanes of the wind wheel with circular sides or rims, between which and the outer case there is a space left, as described; and the attaching a collar to said sides or rims, to admit air to the revolving vanes, said collars being made to run air tight, to prevent the escape of air from the air chamber. The whole being constructed and arranged in the manner set forth."

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29. For an improvement in *Umbrellas and Parasols;* Elisha Hale, Newburg, Orange county, New York, December 28.

This umbrella is constructed so that it can be folded, and slid together in such a manner as that it shall not occupy more than half the length required for those made in the ordinary way.

The claim is to "the forming of the staff of an umbrella or parasol, of two tubes, or of one tube and one solid piece of nearly equal lengths, having springs and catches on them, and sliding one into the other for the purpose of shortening them in the manner of telescope tubes, and in combination therewith, the forming the metallic or other spreaders of an umbrella or parasol, with a division in them, and united by clasps having springs and catches on them, and sliding one on the other to reduce them to nearly one half their extended length, in manner set forth."

There is in the possession of a member of our family, an umbrella which has seen at least forty years service, which possesses all the attributes of that above described; and this is not the only one of the kind that we have seen. So far as the sliding tubes are concerned, we have seen many of such umbrellas and parasols constructed for traveling; but the one first spoken of has the joints in the spreaders, and was, we suppose, made under an English patent. The present

patentee, is, no doubt, the inventor of what he describes and claims, but he has the misfortune of not being the *first inventor*, by a period of about half a century.

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30. For a *Sifter of Coal and Ashes;* Horace Welles, Hartford, Hartford county, Connecticut, December 31.

This apparatus consists of a box of sheet metal somewhat deeper and higher than the ash drawer of the stove, the coal and ashes from which are to be sifted. There is an opening in the metallic case fitted for receiving the drawer with its contents, and when in place, the sifter is to be inverted, and upon shaking it, the ashes will pass through a riddle, formed by a perforated plate, or by bars, fixed in the box, so as to cover the top of the drawer. After this shaking, the box is to be turned on its back end, to allow the ashes to pass into a space behind the drawer, which space, from the length given to the box, forms a suitable receptacle for them. The case is next to be turned on its bottom, and the drawer containing the coals, withdrawn, when the ashes may be thrown out by turning the box on its front. The claim is to the combination of the respective parts, as above described. We do not wish to purchase one of these sifters, it has too many conveniences about it.

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31. For a *Tape, or Chalk Line Winder;* Gerard Sickles, Middletown, Middlesex county, Connecticut, December 31.

This winder consists of a cylindrical bobbin, upon which the tape, or line, is to be wound, and which, we suppose, is to be made of tin plate, or other sheet metal. It is inserted within a cylindrical case, through which there is a slat, or hole, for the passage of the tape, or line. The inner cylinder, or bobbin, is hollow, and to this the inner end of the tape, or line, is attached. A ring, into which to pass the end of the finger, serves to give a revolving motion to the bobbin, when the line is to be wound on to it. The claim is to "the mode described, of constructing a reel without a shaft, revolving within a case."

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32. For a *Railway Safety Brake;* George S. Griggs, Roxbury, Norfolk county, Massachusetts, December 31.

(We have cuts of this apparatus, and will give the specification, with some testimonials of its action.)

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33. For a *Substitute for Oil for burning in Lamps;* Isaiah Jennings, city of New York, December 31.

(See specification.)

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34. For a *Hat Colouring Machine;* George M. Johnson, Port Deposit, Cecil county, Maryland, December 31.

This machine very much resembles some of those used for dipping candles, which machines have arms extending out from a vertical shaft, which arms carry the candles to be dipped over the kettles containing

the tallow. Substitute hats for candles, and let the arms have on their ends boards furnished with suitable pegs, by which to confine the hats in place, that are to be dipped into the kettle, and you have the present machine; the arms vibrate and allow of the articles upon them being lowered into the kettles. The object is to immerse into the kettle, and to raise from it a suit of hats, and to swing them round out of the reach of the steam, thus giving them a perfect chance to become cool. The claim is to "the method of putting the suits in and out of the kettle, and swinging the suits round so as to let them cool whilst other suits are colouring, as described."

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35. For an improvement in *Tanning;* Lewis R. Palmer, Maryland, Otsego county, New York, December 31.

This improvement consists of "a machine for changing the hides from one vat to another, and expressing the exhausting liquor therefrom. The nature of the invention consists in a certain new and useful arrangement of loose rollers on an horizontal axle, placed above and parallel with a revolving cylinder, between which the hides are pressed, and by which the exhausted liquors are expressed therefrom, however uneven the surfaces of the hides may be, which cannot be effected by parallel cylinders of equal length."

The claim is to "the before described combination and arrangement of the parallel, loose, revolving rollers with the revolving cylinder placed below the same, between which the hides are drawn for pressing the exhausted liquors therefrom, in the process of tanning leather.

The loose rollers are cylindrical rings arranged side by side on the upper horizontal shaft, the perforations in their centres being of such size as to allow them to play upon the shaft, and to bear, by their separate weights, upon the hide beneath them.

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36. For an improved *Kitchen Range;* Ebenezer Barrows, Mattapoisett, Plymouth county, Massachusetts, December 31.

We cannot, without devoting too much space to the subject, attempt to describe the peculiarities of this range; we know, however, that it has afforded full satisfaction to numbers who have used it in the city of Boston, where it has been extensively introduced.

The claim is to the peculiar arrangement of the valves and flues, with other devices set forth in the specification.

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37. For an improvement in *Constructing Circular Saws;* Menassah Andrews, Bridgewater, and James Sproat, Taunton, Massachusetts, December 31.

The object of this improvement is "to relieve the collar of a circular saw used for the purpose of sawing boards, shingles, and other articles, from the friction occasioned by the pressure of the article sawed, as it is separated from the block upon the collar of the saw." To effect this, a stationary curved plate is fixed to the frame of the machine, at the back of the saw, against which plate the stuff sawed is to bear,

as it is curved off from the saw, instead of bearing against the collar. The edge of this plate, nearest to the edge of the saw, is received behind a shoulder, or offset in the collar, thus insuring the end of the piece sawed, a passage on to the face of the plate.

The claim is to "the countersink in the collar, as described, and the insertion of the stationary plate, or reliever, as described, in such manner as to receive upon its edge the article sawed, as it is separated from the block."

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38. For *Cutting Seats, Slats, or Grooves, in Hubs, &c.;* Thomas J. Butler, Johnstown, Cambria county, Pennsylvania, December 31.

By turning to vol. xix. p. 30, of the last series, a specification of an apparatus for the same purpose with that above named, will be found, as granted to Francis Barker, of Baltimore; not only the purpose, but the means of accomplishing it, are substantially the same in the two plans. The date of Mr. Barker's patent is not mentioned, as it was probably among those granted a little time previously to the burning of the office. The specification of Mr. Butler's patent was prepared by the editor, who, at the time of writing it, was fully impressed with the conviction that the apparatus had been already patented; but it was not to be found in the office, and from the want of a date, and place on the list, it was overlooked both by the editor, and in the patent office; a kind of accident which is not of frequent occurrence.

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39. For *Propelling Steamboats;* Benjamin D. Beecher, Prospect, New Haven county, Connecticut, December 31.

The mode of propelling described by the patentee, is intended, principally, for canal boats. "The invention consists in constructing the bow, or fore part of the boat, so as to accommodate the screw or other propellers which I place there, which are intended, by their particular position, and mode of action, to draw the water directly from the bow, and to give it, as it passes towards the stern, such a direction as shall greatly diminish the resistance offered to the passage of the boat." The propelling is to be, in general, effected by means of two spiral or screw wheels, placed immediately in front, so as to extend completely out to the cutwater; and the claim is to "the manner of locating the two propellers in the bows of the boat, in combination with the manner in which I construct and extend the bottom of the boat forward, and thus causing the propellers to act upon the water in a direction inclined from each other, in the manner, and for the purpose, set forth."

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40. For preserving the *Equilibrium of Steamboats;* Samuel M. Purse, and Martin Staley, Ashley, Pike county, Missouri, December 31.

The claim shows pretty clearly the nature of this invention, and is in the following words. "What we claim as our invention, and

desire to secure by letters patent, is the preserving the equilibrium or trim of steamboats, by means of an apparatus operating substantially in the manner of that herein described; that is to say, the combination of a pendulous weight, clutch, gearing, and weighted carriage, or suspended weights, as set forth, for the purpose of preserving the trim of boats, and thus improving their speed, and obviating a frequent cause of explosions."

A shaft is sustained on the deck of the vessel in the direction of its length; and from this is suspended a pendulous weight, by the swaying of which, from side to side, the shaft will be turned partially around. This shaft is geared into a rack on the bottom of a loaded truck, placed on ways across the deck, which will be moved in a direction opposite to that towards which the pendulum swings. The shaft may also be geared to a crane carrying a suspended weight, which will consequently be swung from side to side, as required.

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41. For an improvement in *Fire Arms;* Silas Day, and Samuel Hall, city of New York, December 31.

The claim under this patent is to "the method of retaining the extra breech in its place in the barrel, by means of the projection on the extra breech, to which is attached the nipple, fitting into a corresponding recess in the breech plate of the barrel; but we do not claim as our invention the entire extra, or movable breech, which contains the charge." We do not think it necessary to give further particulars, at present, and doubt whether they will ever be called for.

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42. For an improved *Wool Carding Machine;* Nathan Freeman, city of Lowell, Massachusetts, December 31.

This improvement consists, mainly, in dispensing with the upper feeding roller, and placing in its stead, and between the remaining feeding roller and the main cylinder, a bar, so formed as to be nearly in contact with the carding cylinder, and allowing room between it and the feed roller for the passage of the wool, which space diminishes from the point at which the wool enters, to the point of its delivery on to the carding cylinder, which is in a line with the axis of the cylinder and roller. The apparatus is very clearly described; and in its use it is said that "the wool being conveyed and supplied to the feeding roller by means of an endless apron, or drawings, or bats, or in any other convenient way, is carried towards the end of the lip of the bar, and while pressed between it and the feeding roller, and passing the end or edge of the lip is operated upon by the teeth of the main cylinder, tumbler, or carding cylinder, as the case may be, and the fibres of the wool are broken, separated, straightened, and operated upon, and the knobs of wool are disentangled, so as to card the wool better and more effectually than it can be done in the ordinary way."

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43. For a machine for *Manufacturing Lead Pipes;* Joseph C. Vaughan, and Frederick Leach, Tioga, Tioga county, New York, December 31.

This is a rolling apparatus for rolling pipes of cast lead, so as to reduce them in size. There are four rollers consisting of disks of metal of the proper thickness for combining them together, so that they shall, when properly fixed, leave an opening at the place of junction of their peripheries, of the size and form of the exterior of the pipe; for this purpose their edges are fluted in such manner as that each constitutes a fourth of a circle. These four rollers are so placed as that they shall each stand at right angles to the two which are next to it, and they meet by a mitre joint at their edges. A vertical core, or mandrel, is fixed to the frame work of the machine, its lower end passing between the rollers. Upon this mandrel the cast lead pipe is to be placed, and the rollers being properly geared, and made to revolve, the pipe will be rolled out to the desired size. The mandrel is to be made hollow, so as to contain oil, a portion of which is allowed to ooze through small openings at its lower end.

"What we claim as our invention, is the employment of four rollers in combination with the fixed mandrel, in the manner, and for the purpose, herein described; and also the making of the mandrel hollow from the top to near the bottom, to contain oil, and provided with small holes to allow the oil to percolate, and thereby prevent the lead from adhering to the iron."

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44. For a *Cooking Stove;* John L. Lathrop, Provincetown, Barnstable county, Massachusetts, December 31.

This stove is to be made in the form of a Franklin, but is to be furnished with an oven, and other means of cooking; its appearance is therefore more like that of the old fashioned caboose, than of a Franklin stove. We shall not enter into any description of it, but only give the claim, which is to "the combination and arrangement of an upper and a lower diagonal partition, for the purpose of causing the smoke to pass around the oven, in the manner described."

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45. For a machine for *Cutting Nails;* Henry Waterman, city of New York, State of New York, December 31.

"The intent of this machine is to cut nails with a point somewhat of a blunt chisel form, and to give a shoulder on each side of the head by the cutters, thereby producing a nail that will enter easily, and drive and hold well; such mode of cutting being mostly applicable to that sort of nails called brads." This machine, however, is not intended to be confined to brads, but is to cut such nails also as are represented in the notice of Mr. Walter Hunt's patent, in the list for November, No. 11. The drawings of this machine consist of twelve different figures, by which it is fully represented. The claims are necessarily confined to the special construction adopted by the patentee, as every machinist acquainted with nail machines can construct them to cut such nails; nor is there any claim made to the kind of work performed, but only to the manner of performing it.

Specifications of American Patents.

Specification of a Patent for an Improved Manufacture of Cotton Twine; granted to Jacob Sloat, *Statsburg, Rockland county, New York, November 9th,* 1839.

To all whom it may concern: Be it known, that I, Jacob Sloat, have invented a new and improved manufacture of cotton twine, or cord, by which improvement the liability of such cord to kink, stretch, and untwist, is obviated, its durability is increased, and it is rendered equally applicable to various purposes, with the twine prepared from more costly materials; and I do hereby declare that the following is a full and exact description thereof.

I make my twine of various sizes, and by means of the apparatus ordinarily used for that purpose, and I then subject it to the operation of dressing, employing for this purpose any of the dressing machines used for dressing cotton yarn, to prepare it for being woven in the loom, the operation being similar, excepting that the twine or cord, instead of being wound upon a yarn beam, is to be delivered so as to be wound into balls, or otherwise put up for use. Various compositions of starch, gum, glue, or other materials possessing analogous properties, may be used for dressing, the object being to saturate or coat the twine or cord with any suitable viscous substance, which shall have the effect of causing the fibres of cotton to adhere to each other, and consequently to prevent the kinking, stretching, and untwisting of the strands. I have found a mixture of starch and glue to answer the intended purpose perfectly well, and are not aware that any other material is to be preferred either for utility or economy.

I do not make claim to any new machinery to be used either in the process of spinning the twine or cord, or for the purpose of applying the viscous dressing thereto; but what I do claim as my invention is the applying of the well known process of dressing, to cord or twine prepared from cotton in the ordinary way, whereby such cord or twine is greatly improved in its useful properties, and is thereby rendered an essentially new manufacture.

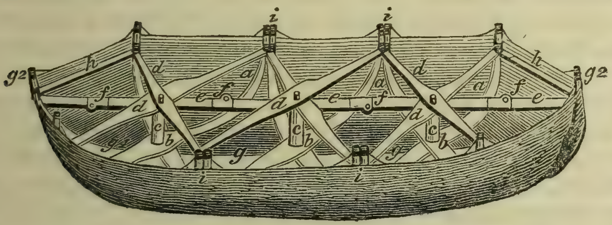
Jacob Sloat.

Specification of a Patent for a Portable Safety Barge and Army Boat; granted to Solomon C. Batchelor, *city of Cincinnati, Ohio, January 20th,* 1841.

To all whom it may concern, be it known, that I, Solomon C. Batchelor, of the city of Cincinnati, in the State of Ohio, have invented an improved boat, which I denominate the portable safety barge and army boat, and I do hereby declare that the following is a full and exact description thereof. My boat or barge is so constructed as to be capable of being doubled up so as to occupy a very small space when it is not in use as a boat. The exterior, instead of planking, consists

of India rubber cloth, or of any other flexible material which is light, readily folded, and impervious to water. When opened out for the purpose of being used, the sides are sustained by suitable ribs of timber, constructed and jointed together in a way to be presently described.

The portion of timber forming the keel is divided into lengths which are connected together by rule joints; and another portion of timber which extends fore and aft, or from stem to stern, directly above the keel and near the upper part of the boat, is in like manner divided and connected by rule joints, so that they may be doubled together, and when opened out, the respective pieces will stand in a straight line, or nearly a straight line; the rule joints connecting the several parts of this timber are so constructed as to open a little beyond a straight line, this forms a kind of lock, as this part acts as a longitudinal stretcher; the two end pieces of the keel curve up so as to constitute a stem and stern post.



The accompanying drawing represents my boat, or barge, in perspective. The pieces of timber which constitute the ribs of my boat or barge, and which are marked *a*, *a*, *a*, consist of hickory, ash, white oak or other tough hard wood, adapted to the purpose; these pieces are to be bent into the form of a bow, so as to constitute, when properly placed, the cross bottom timbers and ribs of the boat; they must, of course, be of such length as will adapt them to the particular purpose to which they are to be applied. These rib pieces are placed in pairs, crossing each other at their middles, as shown at *b*, *b*, *b*, where they work upon joint pins, formed by the lower ends of the vertical standards *c*, *c*, *c*, each of these rib pieces is connected together near its upper end, by a straight stretcher of wood *d*, and when in place, the retrospective pieces *d*, *d*, cross each other, and work on joint pins at the upper ends of the standards *c*, *c*, *c*. The upper fore and aft timbers are marked *e*, *e*, *e*, its parts being connected by rule joints at *f*, *f*, *f*, and it is also jointed to the cross pieces *d*, *d*, by the joint pin upon which they work.

The keel pieces *g*, *g*, *g*, are connected in like manner to the rib pieces *b*, *b*, and work upon joint pins passing through them, and through *b*, *b*, on the lower ends of the standards *c*, *c*; one of the curved end pieces of the keel is seen at g^1, and the upper ends of both of them at g^2, g^2. The two cross pieces *d*, *d*, which are nearest to the ends of the boat, are united by hinge joints to straight pieces of stem

and stern, or bow timber, *h, h,* which are hinged at their other ends to the stem and stern posts. Where two ribs meet at the sides of the boat as at *i, i, i,* they are united by hinge joints; and it will be readily seen that all the timbers may, from the arrangement of joints as above described, be folded together in such manner as that the length occupied by the boat when so folded, will be equal only to that of one of the bow pieces constituting the ribs, and the width only equal to that of three of the cross timbers *d, d,* and the thickness of the stern posts; that is, supposing there are three cross pieces to the boat, as in the drawing; but this number may be increased or diminished at pleasure. I have spoken of stem and stern posts; but these terms must be understood as convertible, the two ends of the boat being similar. A boat upon the foregoing plan, which I have constructed, weighs altogether thirty-five pounds, and it is capable of carrying, very readily, a load of two thousand pounds.

Having thus fully described the manner in which I construct my portable safety barge and army boat, what I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the pieces of timber forming the ribs, the cross pieces by which their ends are sustained, and the longitudinal pieces constituting the keel and the upper timber *e, e;* the respective parts being united by joint pins, hinge joints, and rule joints, substantially as herein set forth, so that the whole, when not in use, may be folded together, and be instantly prepared for use by the mere act of unfolding or opening.

SOLOMON C. BATCHELOR.

Specification of a Patent for a new Combination of Ingredients to be used as a Substitute for Oil, for Burning in Lamps; granted to ISAIAH JENNINGS, *city of New York, December* 31*st*, 1839.

To all whom it may concern, be it known, that I, Isaiah Jennings, of the city of New York, have invented or discovered a new combination of ingredients to be used as a substitute for oil and other combustible ingredients, for burning in the various kinds of lamps now in use; and I do hereby declare that the following is a full and exact description thereof.

In the process of distilling whiskey for making alcohol, or high wines, it is now the practice with some distillers to commence the operation by subjecting the whiskey in the still to a much more intense degree of heat than heretofore, and as the progress of rectification proceeds to lower the fire to the ordinary temperature. The effect of this high temperature is, in the first instance, to drive over a liquor possessed of peculiar properties, intimately related to those of the essential oils. The quantity of this liquor obtained from different parcels of whiskey, will differ, but I think that it will vary but little from two or three gallons to the hundred gallons of common whiskey. Its specific gravity is the same, as nearly as may be, with that of spirits of turpentine, and its reaction is, in many cases, similar. It is

extremely high flavoured, and brings over with it all the highly odorous matter contained in the whiskey, and has, consequently, an offensive smell. The reason for adopting this process by the distiller, is, that by driving over this oil, or spirit, which I shall designate by the name of *oil of whiskey*, the trouble and loss consequent upon rectification by charcoal, are avoided, and an equally pure spirit is obtained.

I have been thus particular in the foregoing description, as this peculiar kind of oil or spirit possesses the property of rendering alcohol and spirits of turpentine capable of combining with each other in proportions in which they do not combine when it is not present; and will also cause spirits of turpentine to combine with whiskey, or ordinary proof spirit.

In making my new compound, the spirits of turpentine may be the predominating ingredient, which cannot be the case when the compound of this spirit with alcohol is used alone. The proportions may, of course, admit of some variation, but the following is preferred. Two parts of spirits of turpentine; one of alcohol of 93° above proof, and one of oil of whiskey. Should alcohol of higher proof be used, the proportion of spirits of turpentine may be increased, but this is not deemed desirable. The advantage derived from this oil of whiskey is such, that were it not added, as above, the alcohol must exceed the turpentine in the proportion of about five to one.

I sometimes combine the oil of whiskey with sperm, or other oil, with turpentine, and with alcohol, or with the sperm oil alone; which last combination will take place in any proportions. When I use the four ingredients I prefer to take about four parts of the oil of whiskey, one of sperm or other oil, one of spirits of turpentine, and one of alcohol.

The fluid which I have denominated oil of whiskey, has, heretofore, been thrown away as worthless, but I have, as above stated, applied it to a highly useful purpose, and obtained a combustible fluid affording a brilliant light, at a cost far below that of the ingredients now in use, and which, when combined, as above stated, has not its offensive smell developed, but burns without odour.

What I claim as my invention or discovery, in the above named combination of ingredients, is the use and employment of what I have denominated oil of whiskey with spirits of turpentine, alcohol, or lamp oil, in the manner, and for the purpose, herein set forth.

ISAIAH JENNINGS.

Specification of a Patent for an improved manner of discharging Fire Arms of various kinds; granted to JOSHUA SHAW, *city of Philadelphia, January* 30*th*, 1841.

To all to whom it may concern: Be it known, that I, Joshua Shaw, of the city of Philadelphia, in the state of Pennsylvania, have invented a new and improved manner of discharging fire arms of various kinds, said improvement being equally applicable, under proper modi-

fications, to the discharge of small arms, such as pistols, fowling pieces, rifles, muskets, and others, and also to the discharging of pieces of ordnance.

In making the discharge, I ignite the powder constituting the charge by means of a percussion cap, charged with fulminating powder in the ordinary way; but when used for the discharging of small arms I employ percussion caps of a size considerably smaller than those in common use; and for the discharge of cannon they need not be larger than those now employed with small arms. A distinguishing feature of my invention is the manner of employing, or using, these caps, which, under all the modifications thereof, is by placing them upon one end of a cylindrical rod, or wire, of steel, which rod, or wire, for distinction sake, I will call a piston; and inserting said piston, with the cap on the end thereof, into a cylindrical opening occupying the place of the ordinary touch hole, or otherwise conveniently situated; said opening being adapted in size to the piston, which is to slide freely, but closely, within it. The cylindrical piston is to be a trifle larger in its diameter than the outside diameter of the cap which is to be placed upon it; its end being turned down, or reduced in size so as to pass into, and to be embraced by the cap. The hole or opening, into which the piston is to pass, is to contain, in some part of it, a piece or pieces of leather, cork, or other elastic substance, which is to embrace the piston, and thus render the passage air and water tight, whilst, at the same time, said material will serve, by its elasticity, to hold the piston in place.

In small arms the hole, or opening, through which the piston passes, may be of equal bore, or diameter, throughout; as the piston is, in some cases, to be of sufficient length to enter the chamber of the barrel, and to extend across it, so that the percussion cap which is placed upon its end may be brought into contact with the interior of the chamber on the side opposite to that at which it entered; and it is manifest that if the outer end of the piston be then struck by a hammer, or mallet, the percussion cap will explode, and the gunpowder will be ignited.

In pieces of ordnance there are sundry objections to the allowing of the piston to extend across the chamber of the gun; and from the thickness of the breach, in arms of this description, a sufficient depth is obtained in the solid metal for the operation of the piston without its entering the chamber of the gun. In using my piston with the percussion cap at its end for the discharging of pieces of ordnance, I bore a hole, in the manner, and generally in the place, of the ordinary touch hole, such hole being of the size of the piston intended to be used, say of three-sixteenths of an inch in diameter, more or less, and extending down nearly to the chamber of the gun, say within a fourth or half of an inch thereof; and through this remaining part I drill a hole of much smaller size, say one sixteenth of an inch, more or less, in diameter, until it enters the chamber. The piston must be of such length as to extend down to the bottom of the larger portion of the bore, and to rise to a sufficient height above the top of it for the action of the hammer by which it is to be struck. Its lower end, or that which

enters the bore, is, as above stated, to be turned down so as to form a nipple for the reception of the percussion cap.

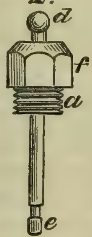
The percussion cap which I use under this modification of my invention, I have improved in such a manner as adapts it especially to the object in view; this improvement consists in the making a small hole, say one sixteenth of an inch in diameter, through the centre of what, in the ordinary cap, is its closed end; this being done before the cap is charged with percussion powder.

When the piston is inserted in the bore, having a percussion cap of the kind just described on its lower end, if the piston be struck by a hammer, or mallet, on its upper end, the cap will explode, and the ignited percussion powder will pass through the hole in the head of the cap, and through the small part of the bore under it, into the chamber of the cannon, where it will ignite the powder.

I sometimes drill a small hole into the end of the piston, in the direction of its axis, which hole may be from an eighth to a fourth of an inch in depth, and of the same size with that in the percussion cap, and also with that leading into the chamber of the gun; this hole is to be filled with common gunpowder, which will be ignited by the percussion powder; by using this device the percussion caps may be very lightly charged with purcussion powder, the gunpower greatly aiding in causing the discharge of the cannon. This is a point of considerable importance, as the destructive influence of the percussion powder upon the parts with which it is in direct contact, is thereby, to a considerable extent, obviated. It may also be remarked that the percussion cap which remains upon the piston after the discharge, has the effect of protecting it, and the adjacent parts, from injury by the percussion powder.

Fig. 1.

2.



I will now exemplify, by reference to the accompanying drawings, the manner in which my improvements may be carried into actual operation. Figs. 1 and 2, represent modes in which it may be conveniently applied to small arms; in fig. 1, *a*, is a perforated screw nut, which screws into the barrel, at the place usually occupied by the touch hole, or in any other preferred situation; the end of this screw is to be flush with the inside of the chamber; *b*, is a screw on the upper part of this nut, upon which there is fitted a screw cap *c*; the cavity in this cap is somewhat deeper than the length of the screw *b*, in order to admit of the insertion of a piece of leather, or of some other elastic substance, through which the stem of the piston *d*, *e*, is to pass. This stem is to be made perfectly cylindrical, and the holes in the nut and

cap through which it passes are to be made perfectly true, and adapted nicely to it in size, so that such pistons may slide in and out easily, and yet have no shake. Fig. 2, shows a similar device, but more simple in its construction; *a*, is a screw nut which screws into the barrel, but does not pass through into the chamber, there being a solid portion of the barrel below it, with the exception of an opening of such size only as to admit the piston to pass through it. The elastic material, under this arrangement is placed beneath the screw *a*, and is pressed between it and the part of the barrel beneath it. The head *f*, of this screw nut, together with its screw part *a*, receives the piston *d*, *e*, as in fig. 1, its whole construction and operation being substantially the same. The length of this piston is, under this arrangement, to be such as to extend across the chamber of the piece to be discharged. The small percussion cap is received on its inner end *e*, and this must be, as before remarked, somewhat smaller in diameter than the piston. These percussion caps are, in other respects, constructed in the ordinary manner.

Any required number of these pistons, armed with their caps, may be conveniently carried by arranging them in holes prepared for their reception in the stock, or breeching part of the gun or pistol, or they may be disposed of in any way which will admit of their being readily applied when wanted.

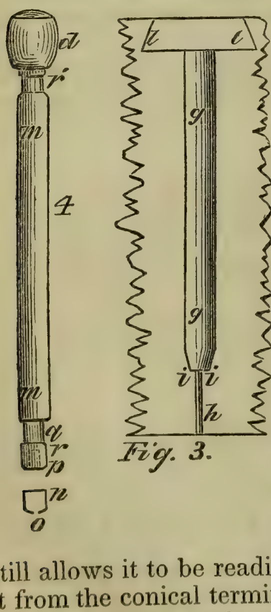


Fig. 3.

Fig. 3, is a section through the touch hole part of the breech, or ventfield of a piece of ordnance, showing the manner in which I drill or bore through this part for the insertion of the piston, and the exploding of the cap; and fig. 4, is the piston; *g*, *g*, is the part of the bore which is to receive the cylindrical piston fig 4; and *h*, the lessened aperture leading from the lower end of *g*, *g*, into the chamber of the gun, thus leaving a shoulder at *i*, *i*, against which the percussion cap is to be forced when the discharge is to take place. I have said that the bore *g*, *g*, should be perfectly cylindrical, and this is true, excepting that there is a slight contraction at its lower end, in the part which embraces the percussion cap at the time of the explosion; this part being made slightly conical, to the height of from an eighth to a quarter of an inch, which causes it to embrace the cap the more closely after the blow, and still allows it to be readily withdrawn, as the slightest motion relieves it from the conical termination.

I have, in the application of my improvement to cannon, devised a very simple mode of using an elastic substance through which the piston is to pass, and by which the entrance through the opening *g*, *g*, is rendered air and water tight. I make a countersink *l*, *l*, at the upper end of the bore *g*, *g*, in which I insert a piece of cork, having a

hole through the middle of it, through which hole the piston will pass, and by which it will be closely embraced. This cork may be firmly held in place by small asperities on the sides of the countersink, by widening the countersink a little towards its bottom, or in various other ways. If preferred an elastic substance may be held down by means of a perforated screw nut inserted in the ventfield, but I think the cork, inserted as above described, is, as I have found it to be, perfectly efficient, and it may be readily and instantaneously renewed. I prefer, in all cases to make the pistons of tempered steel; they are accurately turned, ground, and fitted to the perforations prepared to receive them. In fig. 4, *n*, is a section of the copper cap which is to be placed on the lower end of the piston *m*, *m*, this cap is perforated at *o*, prior to its being charged with percussion powder, the opening being equal in size, or nearly so, to the perforation at *h*. The lower end *p*, of the piston is turned down to receive the cap, and it is diminished in diameter at the part *q*, so as to leave a shoulder at *r*, above which the copper cap rises, and the upper edge of the cap is to be slightly bent inwards so as to embrace this shoulder; and this may be readily effected by holding a piece of steel, say one of the pistons, or a tool kept for the purpose, upon the edge of the cap after it is in place, and rolling it over upon a table. By this means it is made to embrace the piston so firmly as to insure its being withdrawn with it, after the discharge; whilst without this precaution it would be liable to be left behind. The dotted lines at the lower end of the piston show the perforation sometimes made for containing gunpowder.

The discharge is made by allowing a hammer to strike on the head *d*, of the piston, and this may be done by hand, but it will usually be effected by means of a lock, constructed in any convenient form, and adapted to the piece to which it is to be applied.

Having described the manner in which I apply my piston, and its percussion cap for the discharge of pieces of ordnance, I will now observe that I intend sometimes, and shall probably prefer, to adopt a similar arrangement in small arms; that is to say, to use a piston which shall not enter the chamber of such arms, but which shall be contained entirely within the tubular screw nuts, represented in figs. 1 and 2, or within tubular pieces analogous thereto. In this case I shall use also, the perforated percussion caps, like those used for the discharge of cannon, and allow the percussion powder to pass therefrom into the chamber of the pistol, or the gun, through a perforation smaller than that which receives the piston. The whole arrangement of the apparatus being in this case substantially the same with that described in my application of it to cannon; the main difference being in the size only of the respective parts.

From the smallness of the opening through which the discharge is made from the percussion cap into the powder forming the charge, or from the smallness of the section of the piston used in small arms, when said piston is allowed to pass through the chamber, the reaction from the discharge, tending to throw the piston out, will be but small, and it will be held down by the force of the spring acting upon the hammer of the lock, when a lock is used. When the piston is to be

struck by hand, a button attached to the ventfield of the gun, and bearing on the piston near its upper end, may be used for checking the rise of the piston from the force of the discharge.

5.

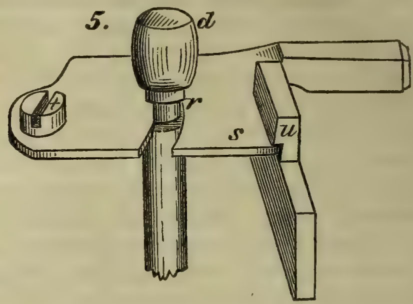


Fig. 5, shows the manner in which the button may be affixed; *d*, is the head of the piston, and immediately under this head there is a shoulder *r*, made by turning the shank of the piston so as to form a neck smaller than the shank; *s* is a steel button which turns on a screw at *t*, and passes under a catch *u*, at its opposite end. The neck of the piston is embraced by the notch in the button *s*, and is thus held from being blown out. The neck is of sufficient length to give the requisite play to the piston, which can be drawn out when the button is turned back.

In cannon and other fire arms constructed as herein described, the vent is not only rendered air and water tight, but the escape of fire and smoke through it is effectually prevented, as has been proved by numerous trials.

Having thus fully described the nature of my improvement, and shown the manner in which I carry the same into operation, what I claim as constituting my invention, and desire to secure by letters patent, is the effecting of the discharge of fire arms by placing a percussion cap on the end of a cylindrical rod, or piston, formed for the purpose, in the manner herein set forth; such piston, with its cap, being made to pass through an opening adapted thereto, either in the body of the breech of the piece to be discharged, or through tubular pieces screwed into, or otherwise attached to it; said piston being of such length as shall adapt it to the respective modifications of my apparatus, as above described; that is to say, I claim the passing of such a piston through a tubular opening allowing it to reach across the chamber, as in my first described modification. Or I pass it into a cylindrical opening extending nearly to the chamber where a shoulder is formed by diminishing the size of the aperture, in the manner, and for the purpose set forth; the respective parts concerned in the discharge, being constructed, and operating substantially as herein fully made known. I claim, likewise, the improvement in the percussion cap, consisting of the perforation through the middle of what is usually its closed end, in the manner, and for the purpose described.

JOSHUA SHAW.

Progress of Practical & Theoretical Mechanics & Chemistry.

Electricity from Steam.

At a stated meeting of the American Philosophical Society, held December 18th, 1840, Dr. Patterson called the attention of the Society to the subject of the evolution of electricity from steam, mentioned at the last meeting, and stated that the experiments made lately in England had been successfully repeated by Mr. Peale, Mr. Saxton, and himself, at the United States' Mint.

Dr. Patterson said, that their first attempts were to collect electricity from the steam as it issued from a gauge-cock, near the surface of the water, in the boiler; but in this case the steam was always accompanied by a spray of water, and the experiments failed. They also failed when the steam was of a low temperature, as it was then condensed immediately upon leaving the boiler, so as to form a cloud of vesicular vapour. In both these cases, the electricity, if evolved at all, would be led back to the boiler—the spray and the vesicular vapour being, as is well known, electrical conductors.

When, on the other hand, high steam was drawn off from a stop-cock far removed from the water in the boiler, it was observed to issue, for some distance, in the form of a transparent gaseous vapour, and, in this case, any insulated body on which it was condensed was always found to be charged with electricity. Thus, if the experimenter stood on an insulating stool, or even on a box or ladder of dry wood, and held an iron ladle, or any other conductor, in the issuing steam, the conductor and the operator became so fully charged with electricity, that thick sparks of a half, three-quarters, and in some instances a whole inch in length, were drawn off; the Leyden jar charged; the shock given to several persons holding hands, &c. The electricity thus produced was found to be always positive.

Dr. Patterson said, that one of the most important conclusions to which the experiments had led, was, that true gaseous steam is a non-conductor of electricity. If it had not been so, the apparatus would not have been insulated, and the electricity excited would have been carried back to the metallic boiler, and thence to the earth.

Dr. Patterson thought it most probable that the electricity, in these experiments, was evolved by the condensation of the steam—the phenomenon being analogous to the evolution of latent heat by the same condensation. He remarked, that as the steam within the boiler was surrounded by conductors, it could not be supposed to contain free electricity, and that on leaving the boiler, the only sources to which the electricity could be ascribed, seemed to be the condensation of the steam, the oxidation of the iron against which it impinges, or the friction of the steam against the air as it rushes through it.

To show that oxidation was not the source of the electricity, the experimenters caused the steam to strike upon a large bar of fine gold (400 oz. in weight,) and the generation of electricity was as abundant

as when they employed an oxidizable metal. The electricity was also evolved by the insulated operator simply holding his hand in the steam as it issued; in which case the steam was condensed upon the hand, and the whole person became charged. Dr. Patterson stated, that this was, in fact, the experiment accidentally made near New Castle, in England, and which has attracted so much attention.

To show that the electricity was not caused by the rushing of the vapour through the air, Dr. Patterson said, that an apparatus was made, consisting of a pipe connected with the stop-cock on the boiler, a portion of about ten inches in length, near the upper end, being of glass, to produce insulation, and the remainder of lead, wound into a helix, like the worm of a still. This helix was immersed in a bucket of water and snow. When the steam was admitted, it became entirely condensed within the pipe, so that there was no rush through the air; yet the production of electricity was as abundant as with the former arrangements.

Dr. Patterson took notice of experiments made, half a century ago, by Volta and Saussure, and afterwards by Cavallo, which proved, to their satisfaction, that electricity was evolved during evaporation and condensation, but which have since been called in question by Pouillet and others, who assert, that a mere change of state, not accompanied by chemical change, never gives rise to electricity. He considered the experiments, now made on a large scale, as favouring, if not confirming, the first opinions entertained on this subject.

Dr. Patterson referred to the satisfactory manner in which these new experiments seem to explain the sources of electricity in the thunder storm, and in volcanic eruptions.

He then related an experiment in which an insulated iron ball, and afterwards a bar of gold, was heated, and a small stream of water poured on it, so as to be formed into steam at its surface. The first experiments seemed to show that the metal was charged with negative electricity, but subsequent trials threw doubts upon this conclusion.

Dr. Patterson also described experiments made to determine whether electricity was given off during the solidification of liquids,—the substances used being melted lead, silver and gold. In every case, however, the gold-leaf electroscope failed to exhibit the presence of any electricity.

Prof. Henry stated that he had not seen the sparks from steam; but that he had obtained feeble electricity from a small ball, partly filled with water, and heated by a lamp. He agreed with Dr. Patterson in the opinion, that the source of the electricity was the change of state, but from water to vapour. There was, however, some doubt on the subject; Pouillet had denied the evolution of electricity from the evaporation of pure water. The facts were interesting, particularly on account of the great intensity of the electricity. The results, obtained by the philosophers, which had been mentioned, indicated electricity of very feeble tension, which could only be observed by the most delicate instruments, but here the sparks were an inch in length. If the vaporization of the water were shown to be the source

of the electricity, Prof. Henry thought that the phenomena might be readily explained by the beautiful theory of Becquerel, in regard to the production of the great intensity of the electricity in the thunder cloud. According to this theory, each particle of the vapour carries up with it into the atmosphere the free electricity, which it receives at the moment of the change of state; this, being diffused through the whole capacity of the air, is of very feeble intensity, although of great quantity; but the condensation of the vapour into a cloud affords a continuous conductor, and consequently the electricity of all the particles of the interior, according to the well known principles of distribution, rushes to the surface of the cloud, and hence the great intensity of the lightning. According to this hypothesis, the insulated conductor, placed in the steam, would act not only as a collector, but also as a condenser of the free, but feeble, electricity of the vapour.

Prof. Henry farther stated, in connection with this subject, that he had been informed by several persons, that they had obtained sparks of electricity from a coal stove during the combustion of anthracite. A case had been stated to him several years ago, which he mentioned to his friend Professor Bache, who informed him that a similar one had fallen under his own notice, in which, however, Prof. Bache had succeeded in tracing the electricity to the silk shirt of the person who drew the spark. Another case had lately been reported to him by an intelligent gentleman, of a stove burning bituminous coal, on board of a steamboat on the Ohio, which afforded amusement to all the passengers during the voyage, by giving sparks of electricity whenever it was touched.

In connection with the facts that had been stated of the production of electricity from steam, Prof. Henry observed that he was now inclined to believe that electricity may also be evolved during the combustion of coal in a stove. But what, he asked, is the source of electricity in this case? Is it combustion, the evaporation of the moisture, or the friction of the hot air on the interior of the pipe?

Dr. Goddard stated, that in the case of a stove, pretty well insulated, his family had amused themselves with drawing sparks half an inch or three quarters of an inch long; and that similar sparks were obtained from the frame of a looking-glass over an open grate, in the house of Dr. Norris, of this city.

Professor Bache remarked, that in the case referred to by Professor Henry, in which sparks of electricity were obtained from a stove, he had satisfied himself that these were owing to the experimenter wearing a silken shirt:—an experimenter, not similarly clad, being unsuccessful.

Dr. Hare ascribed the incredulity and the opinions which he had expressed, when this subject was brought before the Society by Mr. Peale, at the last meeting, to a misapprehension, on his part, as to the circumstances. He considered that the fact of electricity being developed in the case adduced was established. He alluded to the almost incredible case of a lady, who, agreeably to evidence mentioned in Silliman's Journal, gave off sparks of electricity. He stated also the result of an experiment to discover whether electricity was given

off during the rapid evaporation of a saline solution. There was no evidence of excitement. The vessel was of glass.

Mr. Lea had frequently observed sparks from a common grate.

In reference to the results of experiments by Dr. Patterson, in which no evidence of the development of electricity was observed in metals, whilst undergoing a change from the liquid to the solid state, Dr. Goddard observed, that in cases of crystallization on the large scale, as of nitre, in the extensive chemical works of Mr. Wetherill, a beautiful flash of electrical light was apparent.

Professor Rogers suggested, that in ordinary combustion there may be a constant development of electricity, and that means may possibly be found to render it apparent by perfect insulation.

Professor Henry stated, that Pouillet had found that electricity is developed by the combustion of charcoal, and he offered some suggestions as to the mode of rendering the electricity, given off from a stove, apparent, by insulating it both above and below.

Dr. Emerson thought, that the change of state from solid to liquid, and from liquid to solid, might account for various electrical phenomena presented by the animal body. Dr. Hare suggested the difficulty, that the human body is a good conductor; and that without a peculiar organization, analogous to that with which nature has endowed the Torpedo or Gymnotus, it is inconceivable that electrical discharges could arise from vital organization. He believed it was admitted by electricians, that there could be no electrical excitement without the existence of the opposite electricities. Agreeably to the published facts of the case to which he had alluded, the lady was permanently in one state of excitement, generating electricity, as animal heat is generated, and throwing off the excess in sparks.

In the case of the Gymnotus the intensity, Dr. Hare remarked, is so low that sparks are with difficulty rendered apparent at a kerf made by a knife in tinfoil; of course, the sparks alleged to be given by the lady were vastly more intense. From the Gymnotus, sparks could only be received by forming a circuit with a portion of the organic series situate parallel to the spine. Contact in a transverse direction was not productive of any discharge.

Proceedings Amer. Philos. Soc.

Corrosion of Cast Iron and Wrought Iron in Water. By Robert Mallet, A. I. C. E., *&c.*

[From the "Transactions of the Institution of Civil Engineers."]

This communication is one of those forwarded to the institution in consequence of the council having considered this subject a suitable one to compete for the Telford Premiums; and the author having been long engaged in making experiments on this subject, at the request of the British Association, refers, in the introductory part of this paper, to the contents of that report, which may be viewed as a "*précis*" of the state of our knowledge on the subject to the year 1839, together with original researches, forming the basis of the present results. This communication is accompanied by a most elabo-

rate set of tables of results; but these laborious investigations being yet in progress, the author directs his special attention to so much only of the subject as may be necessary for their elucidation—divesting his remarks as much as possible of a purely chemical character, and confining them to those practical conclusions which are of immediate use and importance to the engineer.

The tables of results are altogether twelve in number. The first five contain the data and results of the chemical or corroding action of sea and fresh water on cast and wrought iron under five several conditions, during a period of a year and ten months; and these five series of experiments are so co-ordinate with each other as to form one connected and comparable whole, whence the relative rates and absolute amounts of corrosion of cast and wrought iron—by, 1, clear sea water; 2, foul sea water; 3, clear sea water at temperature 115° F.; 4, foul river water; and, 5, clear river water—may be ascertained. The corrosive action of water and air combined produces on the surface of cast or wrought iron a state of rust possessing one of the five following characteristics—1, uniform; 2, uniform with plumbago; 3, local; 4, local pitted; 5, tubular—or of two or more of these characteristic conditions in combination; these facts, for eighty-two different specimens of British and Irish cast iron, together with their original external characters, mode in which they were cast, specific gravity, dimension and weight before and after immersion, loss of weight per square inch of surface—this loss referred to a standard bar, and the weight of water absorbed for clear sea water, compose Table I. The four subsequent tables contain similar results for specimens of iron immersed under the other four conditions mentioned above. These five tables contain also the results of the corrosion of certain cast irons protected by either of ten several paints or varnishes, the results of which are comparable with those for the unprotected iron. Table VI. exhibits a general comparison of the results set forth in the preceding tables for specimens of iron one inch thick, and reduced to one common or equal period of immersion. Table VII. shows the average loss of all varieties of cast iron experimented on per square inch of surface. Table VIII. the average calculated amount of corrosion (assumed uniform) of various specimens of cast and wrought iron per superficial foot of surface at the end of one century. From these tables it appears that the metallic destruction or corrosion of the iron is a maximum, in clear sea water, of the temperature of 115° F.—that it is nearly as great in foul sea water—and a minimum in clear fresh river water.

Iron, under certain circumstances, is subject to a peculiar increase of corrosive action—as, for instance, cast iron piling at the mouth of tidal rivers—from the following cause. The salt water being of greater density than the fresh, forms at certain times of tide an under current, while the upper, or surface water, is fresh; these two strata of different constitution coming in contact with the metal, a voltaic pile of one solid and two fluid elements is formed; one portion of the metal will be in a positive state of electrical action with respect to the other, and the corrosive action on the former portion is augmented.

The lower end of an iron pile, for instance, under the circumstances just mentioned, will be positive with respect to the other, and the corrosion of the lower part will be augmented by the negative state of the upper portion, while the upper will be itself preserved in the same proportion. From this theoretical view may be deduced the important practical conclusion, that the lower parts of all castings, subject to this increased action, should have increased scantling.

The increased corrosive action of foul sea water may be referred to the quantity of hydrosulphuric acid disengaged from putrifying animal matter in the mud, converting the hydrated oxides and carbonate of iron into various sulphurets, which again are rapidly oxidised further under certain conditions, and, becoming sulphates, are washed away—hence the rapid decay of iron in the sewage of large cities, and of the bolts of marine engines exposed to the bilge water. The corrosive action being least in fresh water, may be partly referred to this being a worse voltaic conducting fluid than salt water.

It appears also that wrought iron suffers the greatest loss by corrosion in hot sea water—which fact has led the author to inquiries, with reference to marine boilers, at what point of concentration of the salt water, whether when most dilute, after the common salt has begun to deposit, or at a farther stage of concentration, the corrosive action on wrought iron is the greatest, and he points out the important practical use which can be made of this information. It appears also, that the removal of the exterior skin of a casting greatly increases the corrosive action of salt water and its combined air, so that the index of corrosion under these circumstances is not much less than that of wrought iron, and in clear river water is greater.

It farther appears, that chilled cast iron corrodes faster than the same sort of cast iron cast in green sand, and that the size, scantling, and perhaps form of a casting, are elements in the rate of its corrosion in water. The explanation of these facts is to be found in the want of homogeneity of substance, and the consequent formation of numerous voltaic couples, by whose action the corrosion is promoted. It is also observable that the corroded surface of all these chilled specimens is tubular.

It appears also, that in castings of equal weight, those of massive scantling have proportionately greater durability than those of attenuated ribs and feathers—hence appears also the great advantage of having all castings (particularly those intended to be submerged) cooled in the sand, so as to insure the greatest possible uniformity of texture. The principles now stated afford an explanation of the fact often observed, that the back ribs of cast iron sheet piling decay much faster than the faces of the piles. It is also probable that castings in dry sand and loam will, for these reasons, be more durable than those cast in green sand. The general result of all these experiments gives a preference to the Welsh cast iron for aquatic purposes, and to those which possess closeness of grain. Generally, the more homogeneous, the denser and closer grained, and the less graphytic, the smaller is the index of corrosion for any given specimen or make of cast iron.

Mining Jour.

New method of Analysing Sulphurous Waters.—Iodine as a test for Hydro-Sulphuric Acid.—Sulpho-Hydrometer. By M. Alphonso Dupasquier.

Being occupied in making a complete history of the fine establishment which has lately been founded near the sources of Allevard (Isere,) M. Dupasquier has devoted himself, with peculiar care, to the analysis of the sulphurous water which they so abundantly yield. He has studied it very accurately, and his investigations have led to the discovery of a process, as simple as delicate, for detecting and ascertaining the proportion of hydro-sulphuric acid, free or combined, contained in mineral waters.

Tincture of iodine, poured into a liquor impregnated with hydro-sulphuric acid, completely decomposes that acid, and so instantaneously, that it is very easy to ascertain the point at which its decomposition is finished, and when the iodine no longer enters into combination. Setting out from this observation, which is his own, it occurred to M. Dupasquier that, by using a carefully prepared tincture of iodine, he might be able, from the quantity of iodine required for saturating a quart of sulphurous water, to deduce the proportion of free or combined hydo-sulphuric acid which it contained.

This opinion has been confirmed by experiment, and M. D. has rendered his new method of analysis extremely convenient, by means of an instrument which he calls a sulpho-hydrometer. This instrument is a graduated tube, filled with tincture of iodine, one extremity of which is closed by a cork, whilst the other is tapered, and terminates in a capilliary aperture, which allows the tincture of iodine to run out, drop by drop, when the cork is removed.

To use the sulpho-hydrometer, a given quantity of sulphurous water is poured into a porcelain capsule; a few drops of a very clear solution of starch are then added; then the tincture of iodine is gradually dropped into it, taking care to assist the action by stirring. So long as any traces of hydro-sulphuric acid remain, the iodine deprives it of hydrogen, precipitating its sulphur, and immediately disappears, without colouring the starch; but from the time that the saturation is complete, the least trace of free iodine is sufficient to communicate to the liquor a fine blue colour. The number of degrees that the tincture of iodine is lowered in the sulpho-hydrometer, must then be reckoned; each degree represents one centigramme of iodine, and each tenth of a degree one milligramme. The quantity of iodine necessary to saturate a quart of sulphurous water being thus given, it is very easy to ascertain how much hydro-sulphuric acid the water contained, by determining the equivalent of the iodine in the hydrogen, the volume of which being known, we have that of the hydro-sulphuric acid.

To render the use of his instrument more easy, M. Dupasquier has prepared a table, indicating in weight and bulk, the quantity of hydro-sulphuric acid, represented by 1, 2, 3, &c., 100 centigrammes, 1, 2, 3, &c., milligrammes of iodine.

This mode of analysis, independent of giving results of the strictest accuracy, has also the advantage of being so expeditious, that fifteen

or twenty experiments may be made in less than an hour. It is also so simple, that it is not necessary to be a chemist to determine the proportion of hydro-sulphuric acid contained in a mineral water; any intelligent person may ascertain the variations in the strength of sulphurous waters, caused by atmospheric influences, or by the mixture of rain water. Among other advantages which this method presents, M. Dupasquier holds up to notice its extreme delicacy, which is so great, that it indicates the precise quantities of hydro-sulphuric acid in waters on which other re-agents would have no action, although they evidently exhibit a sulphurous character. Tincture of iodine may, indeed, he has ascertained, unequivocally detect one drop of a concentrated solution of an alkaline hydro-sulphate, diluted in a hectolitre of water, whilst known re-agents become powerless when it is diluted in ten quarts.—*Annales de Chimie et de Physique.* Mining Rev.

Patent Wire Rope.

It has been our desire to enter more fully into the merits of this patent than we had space on the former occasion, when directing attention to its applicability, both with regard to economy and security for our mines, but we have not yet been in a situation to afford a notice so satisfactorily as we could wish, the information we contemplate receiving not having come to hand. In its absence we have only to note the additional trial made at the Chain Cable Proof House, at Withymoor, near Dudley, on the 25th ult., of which the following is a copy of the certificate signed by Mr. Lewis, the proprietor of the machine:—

Description.	Size.	Bore without Breaking.	Broke at	Second Breaking.	Third Breaking.	Weight per Fathom.
	Inches.	Tons.	Tons.	Tons.	Tons.	lbs. oz.
Flat	4 by $\frac{1}{2}$	11	$11\frac{1}{2}$	6	3	7 6
"	$3\frac{1}{2}$ by $\frac{3}{8}$	7	$7\frac{1}{2}$	4	1	4 15
"	3 by 3-16	2	$2\frac{1}{2}$	2	..	2 5
Round	3-inch.	$16\frac{1}{2}$	17	8	3	7 0
"	$2\frac{1}{2}$-inch.	12	13	5	2	5 13
"	$1\frac{3}{4}$-inch.	$6\frac{1}{2}$	7	4	1	2 13

From this it will be seen that, in addition to the strength of tension employed previous to breaking, instead, as in the case of cable or hempen rope, of its breaking short, it required three separate strains to break it entirely. We have been favoured with a letter from a friend in the north who has just received some, and who promises to advise us of the results of trial to which he intends to submit it. Specimens of the various descriptions may be seen at the Polytechnic Institute, Regent street, and at the Adelaide Gallery, as also at our office. The increasing demand for the article, and the test it has borne of some years' trial by the Admiralty, is the best report upon, and evidence of, its superiority. We should think it peculiarly well adapted for the London and Blackwall Railway, where, we understand, the rope has

snapped some half-dozen times. The size of the rope used there is, we believe, 6½ in., and the cost of a single rope 1250*l.* Mining Jour.

New Process for Making Sulphuric Acid.

M. Provostaye, of Paris, has proposed the following process:—He recommends introducing into the leaden chamber sulphuric acid, nitric acid, and the vapour of water. To understand what takes place under these circumstances, a current of sulphurous acid may be passed into a flask containing nitric acid; this should be made, by means of a bent tube, to communicate successively with a flask containing sulphuric acid, a globular vessel moistened with water, and a dry globe. The nitric acid is completely decomposed. The first flask contains pure sulphuric acid alone. Red vapours pass from the first vessel into the second: this is filled with sulphurous acid also, for it is formed of solid white crystals, in the two last experiments, as in the first. In the latter, all the sulphuric acid of the second flask exists in a solid crystallized mass, of a greenish yellow colour. The re-actions are, therefore, similar to those of the old process. In the new process, the nitric acid yields a portion of its oxgen to the sulphurous acid, in order to convert it into sulphuric acid. Hyponitric acid is thus formed, which acts like the hyponitric acid in the old process, which is formed from the binoxide of azote and oxygen of the atmosphere—that is to say, successively it yields oxygen to the sulphurous acid, and borrows it from the air: but the discharge requires the intervention of sulphuric acid and water. The water has two very distinct functions, it acts directly, by bringing into more intimate contact the sulphurous acid and hyponitric acid, and this favours the oxidation of the first by the oxygen of the second; it acts also by decomposing the white crystals immediately, and changing them into sulphuric acid and oxide of azote. Ibid.

Cornish Engines.

A deputation from the Dutch government having visited Cornwall in order to ascertain, by actual inspection, whether the duty performed by the steam engines employed in the mines is equal to what is stated in the monthly reports, the adventurers and agents of the under-mentioned mines kindly permitted an experiment of six hours to be made on their several machines, and the duty as stated below was the result:—Wheal Vor, Borlase's engine, 80 inches single, 8,0 feet stroke, 123,300,593 lbs. lifted one foot; Fowey Consols, Austen's engine, 80 inches single, 9,0 feet stroke, 122,731,766 lbs. lifted one foot; Wheal Darlington engine, 80 inches single, 8,0 feet stroke, 78,257,765 lbs. lifted one foot; Charlestown United Mines, 50 inches single, 7,5 feet stroke, 55,912,392 lbs. lifted one foot; Charlestown United Mines Stamping engine, 32 inches single, lifting 66 stamps, 60,525,000 lbs. lifted one foot; Wheal Vor Stamping engine, 36 inches double, lifting 72 stamps, 50,085,000 lbs. lifted one foot.—*Lean's Engine Reporter.* Railway Mag.

Progress of Physical Science.

Geological Specimens found on the Great Western Railway.

During the formation of the line, there were numerous difficulties to encounter, in respect of the number of tunnels, there being no less than five, which, of course, presented a wide field for the geologist. The finest specimens of any antediluvian remains were those of an Icthyosaurus, found in a bed of blue lias limestone, presenting the head, teeth, vertebræ, and ribs, in a most perfect state, the length being from twelve to fifteen feet. The bed of stone in which it was found was broken in half, on account of its immense thickness, for the better enabling its removal with safety. It is still in possession of the Great Western Railway Company, at Bath. Various specimens of the cornua ammonia were also found of all sizes, some of very large dimensions, and others much smaller, appearing as having just come from the hands of the gilder, being covered with a mineral incrustation, and generally found in a bed of wet blue marl.

Near the foundation of an old Roman villa (an account of which appeared in our Journal at the time) were discovered the tusks of an elephant, buried about twenty-five feet in a bed of gravel, which, from its appearance, could not have been removed or disturbed for centuries; and whether deposited there at the Flood, or at some later period (most likely during the earlier part of the Roman sway in this country) must remain for more experienced geologists than myself to decide. Near the same spot was discovered an old stone coffin, formed so as to contain three bodies, being built of the oolite or Bath stone, and which, upon being opened, presented to view a small quantity of bones.

It has often afforded me matter for wonder, that amongst the directors and shareholders of some of our leading railways, something has not been done at the different stations for the establishment of a Museum, in which a collection of all specimens found on the different works should be kept open for the benefit of the passengers and the public in general. Mining Jour.

*Abstract of the Proceedings of the Physical Section of the British Association, at the Glasgow Meeting.**

Continued.

Propagation of Heat through different Strata.

Professor Forbes finds from the mean of experiments made in 1837, 8, and 9, upon the propagation of the heat received from the sun's rays through strata, consisting of trap rock, pure loose sand, and sand stone, the following rates of propagation.

* From the Proceedings given in the London Athenæum for October, 1840.

For one foot in depth, the relative rates of conduction are:—in trap, 7.4, in loose sand, 7.0, in sand stone, 4.4.

Cause of the Phenomenon in Vision called "Muscæ Volitantes."

Sir David Brewster has examined this phenomenon with the following results:

1. That in persons of all ages, and with the most perfect eyes, transparent filaments or tubes exist in the vitreous humour, at different distances from the retina. 2. That these filaments float in the vitreous humour, moving about with the motion of the head. 3. That these filaments are seen by means of their shadows on the retina, and are most distinctly visible in divergent light; these shadows being bounded by fringes produced by diffraction or inflexion. 4. That the real muscœ resembling flies, are knots tied, as it were, on these filaments, and arising from sudden jerks or motions of the head, which cause the long floating filaments to overlap and run into knots. 5. By making experiments, the limits of the motions of the muscœ; by measuring their apparent magnitude, and producing double images of them by means of two centres of divergent light, the author was able to determine their exact place in the vitreous humour; and to ascertain the important fact that the vitreous humour in the living human eye is contained in cells of limited magnitude, which prevents any bodies which they contain from passing into any of the adjacent cells. Sir David Brewster concluded with the following observations. "I have dwelt thus long on the subject of the *muscœ volitantes*, not only because it is an entirely new one, but also on account of its practical utility. Mr. Mackenzie informs us 'that few symptoms prove so alarming to persons of a nervous habit, or constitution, as *muscœ volitantes,* and they immediately suppose that they are about to lose their sight by cataract or amaurosis. The details which I have submitted to you prove that the *muscœ volitantes* have no connection with either of these diseases, and are altogether harmless. This valuable result has been deduced from a recondite property of divergent light, which has only been developed in our own day, and which seems to have no bearing whatever of an utilitarian character; and this is but one of numerous proofs which the progress of knowledge is daily accumulating, that the most abstract and apparently transcendental truth in physical science will, sooner or later, add their tribute to supply human wants, and alleviate human sufferings. Nor has science performed one of the least important of her functions, while she enables us, either in our own case or in that of others, to dispel those anxieties and fears which are the necessary offspring of ignorance and error.' "

Report of the Committee on Combined Magnetic Observations.

The Committee reported that the series of simultaneous magnetic observations were now made at between thirty and forty stations,

including the two hourly observations during both night and day, and the monthly term observations, at intervals of two minutes and a half. Observatories have been established at Dublin, by the University, at Greenwich, Toronto, Upper Canada, the Cape of Good Hope, St. Helena, and Van Dieman's Land, besides two itinerant observatories of the Antarctic Expedition, by the British Government, at Madras, Simla, Sincapore, and Aden, by the East India Company, ten stations in European and Asiatic Russia, and one at Pekin, by the Russian Government, one at Prayree, and one at Milan, by the Austrian Government, one at the Girard College, at Philadelphia, one at the University of Cambridge, in New England, one at Algiers, by the French Government, one at Breslaw, by the Prussian, one at Munich, by the Bavarian, one at Cadiz, by the Spanish, one at Brussels, by the Belgian, one at Cairo, by the Egyptian, one at Trevandrum, by the Rajah of Travancore.

Magnetic Observatory at Munich.

Dr. Lamont gave an account of the magnetic observatory of Munich, stating that the building had been commenced in April of this year, and that the regular series of observations, comprehending both the two hourly daily observations, and the term day observations, were commenced on the 1st of August. The magnetic observatory of Munich differs in two respects from other establishments of the same kind. In the first place, it is not a magnetical house, but a subterranean building, which is situated to the S. W. of the royal observatory, at a distance of about 120 feet, and connected with it by a subterranean passage. The depth of the magnetic observatory below the surface of the earth, is 13 feet, thus affording the advantage of a temperature nearly equal, at all times of the year, and rendering the corrections applied to magnetic observations in order to reduce them to a fixed temperature, corrections which are, in general, subject to considerable uncertainty, if not unnecessary, at least sufficiently small to be determined with the utmost degree of accuracy. In the second place, the instruments are of greater dimensions than are usually employed in magnetic observatories, and may be considered as sufficient in all respects for the most delicate investigations. The magnetic bars weigh 25 pounds each, the theodolite has a circle of 2½ feet diameter, and an achromatic telescope of 3½ inches aperture. It may be remarked that the horizontal force instrument differs from the bifilar magnometer, the power that holds the bar in the direction perpendicular to the magnetic meridian, being that of a spiral spring.

Meteorological Observations in Bavaria.

The Royal Observatory at Munich, is the central establishment of the system, which includes observations at no less than two hundred and sixty towns and villages, the observers being either members of a meteorological society, formed for the purpose, or persons employed

by the government. Hourly registry is made at the Munich Observatory, of the temperature and pressure of the air, by self registering instruments.

On the Principles of Electro Magnetic Machines.

Professor Jacobi, of St. Petersburg, infers, from his experiments, the following laws in reference to the magnetism developed by the application of the galvanic current.

1. The amount of magnetism produced in malleable iron by a galvanic current is proportional to the force of the current.
2. The thickness of the wire composing a helix, and surrounding an iron rod, is of no consequence, provided the number of turns of the helix, and the force of the current, remain the same. With thin wires, however, a more powerful galvanic battery must be used, in order to overcome the resistance in the conductors.
3. Generally, in practice, the influence of the coil, may be neglected.
4. The total action of the electro-magnetic helix upon the iron rod, or core, is equal to the sum of the effects produced by each coil separately.
5. The maximum of magnetic effect is obtained from a galvanic current, when the total resistance of the conducting wire, which forms the helix, is equal to the total resistance of the battery.
6. When the diameter of the iron cylinder forming the core of the helix is increased, the length remaining the same, the force of magnetism developed by a given current is increased in the same proportion.
7. A variation in the length of the core only influences the result by admitting a greater number of turns of the helix upon it.
8. The attraction of electro-magnets is proportional to the square of the force of the galvanic current, by which they are formed.

In the last trials made in propelling a boat twenty-eight feet long, seven and a half wide, and drawing two feet and three quarters of water, on the Neva, a velocity of three miles an hour was kept up. The boat carried twelve to fourteen persons. Professor Jacobi remarks that this is the velocity attained by the first steamboat.

In reference to the practical application of electro-magnetic power, Professor Jacobi gives the following rules. 1st. The maximum of mechanical effect is proportional to the square of the number of voltaic elements, multiplied by the square of the electro-motive force, and divided by the resistance of the voltaic circuit. The co-efficient by which these values must be multiplied to give the effect, depends upon the quality of the iron forming the electro-magnets, the form and arrangement of the rods, and the distance between their ends. A battery of platinum and zinc plates produces two or three times the effect of a similar one of copper and zinc. 2nd. The force of the machine varying directly as the square of the number of coils in the helix, and the velocity inversely as the same square, the maximum power is independent of this number. It is also independent of the

dimensions of the electro-magnetic rods. 3rd. The attractive force of the electro magnets, or pressure of the machine is proportional to the square of the force of the current. 4th. The economic effect, or the available power divided by the consumption of zinc, is expressed by the relation between the electro-motive force and the co-efficient spoken of under the first head. 5th. The consumption of zinc while the machine is at rest is double that when producing the maximum effect.

Professor Jacobi concludes his remarks thus:—

"I consider that there will not be much difficulty in determining with sufficient precision the duty of one pound of zinc, by its transformation into the sulphate, in the same manner that in the steam engine, the duty of one bushel of coal serves as a measure to estimate the effect of different combinations. The future use and application of electro-magnetic machines appears to me quite certain, especially as the mere trials and vague ideas which have hitherto prevailed in the construction of these machines, have now at length yielded to the precise and definite laws which are conformable to the general laws which nature is accustomed to observe with strictness whenever the question of effects and their causes arise. In viewing, on the other hand, a chemical effect, the intermediate term scarcely presents itself. In the present case, it is magnetic electricity, the admirable discovery of Faraday, which we should consider as the regulating power, or as it may be styled, the logic of electro-magnetic machines."

Progress of Civil Engineering.

Account of Dircks' Patent Improved Metallic Railway Wheels with Wood-faced Tyre, read by Mr. Henry Dircks, *before the Mechanical Section of the British Association, at Glasgow, Sept.* 19, 1840. *And also before the Polytechnic Society, at Liverpool, Oct.* 8, 1840.

As an introduction to the observations immediately relating to the improved wheel which is the subject of the present communication, a few preliminary observations may serve to make its nature and advantages more generally understood.

Wooden wheels were originally in common use on railways; these were afterwards superseded by the extensive use of cast iron wheels; and both of these descriptions of wheels were much improved by manufacturing them with wrought iron tyres. Modifications of these wheels are still in use on the Liverpool and Manchester Railway, the wooden wheels having the nave of cast iron, and the spokes and rim of wood, the tyre being of wrought iron. On the London and Birmingham Railway, cast iron wheels are extensively used. On the continent of Europe, and in America, cast iron wheels are seemingly employed by preference; and are no doubt quite as safe for traveling, where great speed is not practised.

In England, a decided preference is given to wrought iron wheels,

in which this metal is used throughout, with the exception of the boss being *cast* around the ends of the spokes. The latest improvement on these has been the making of the entire wheel, including the boss, of wrought iron.

The wheels now in general use derive their chief novelty from the construction and placement of the spokes, with a view to obtain elasticity, strength, and durability. One variety which does not come under this denomination, is the plate wheel, supposed on its introduction to possess some peculiar advantage in overcoming a supposed resistance of the atmosphere. Except, however, in relation to variations in size, the present wheels are little more than varieties in pattern. The common diameter of carriage and waggon wheels is three feet, and the largest driving-wheels for locomotives are those employed on the Great Western Railway, being six or seven feet in diameter,—though at one time they were made as large as ten feet.

The action of an iron wheel on an iron rail, though derived from a rolling motion, can only be compared to a series of blows, and the rebound occasioned by iron striking iron is well known to be considerably greater than is produced by striking wood on iron. To this simple fact we may trace the tremulous motion occasioned by iron wheels on an iron railroad; and when, by any trifling accident, as an inequality from the rising of one end of a rail, or sometimes even from small flinty pebbles getting on the rail, the rebound is not more fearful than dangerous. The tremulous motion of the rail just adverted to renders it necessary in most cases to lay the rails on wooden sleepers. As an illustration of what is meant, it may be mentioned that on the Dublin and Kingstown Railway the rails were originally laid on granite sleepers, but the tremor was so great as to loosen the rails, and occasion serious fears from the consequent damage sustained by engines and carriages passing along the line. It was, therefore, ultimately agreed to take up the granite and lay down longitudinal wooden sleepers, a work of considerable labour and expense. In some cases the nature of the soil or sub-soil may allow the use of stone blocks; and where they can be applied with safety, they are preferred, for the reason that a road laid on *stone* blocks can be kept up at a lower rate than one laid on *wooden* sleepers; and, as has been endeavoured to be clearly shown, the only reason for laying the stone aside, arises from the tremor imparted to the rail by iron wheels as at present used.

We shall now proceed to a description of the improved metallic wheel with wood-faced tyre, showing its advantages in connexion with the preceding observations. The construction of the wheel may be understood by imagining a spoked wheel with a deep channelled tyre. The wheel may be made either of cast or wrought iron, it having been ascertained that tyre bars can be rolled to the required pattern. In this channelled tyre are inserted blocks of African oak, measuring about four inches by three and a half inches, solidified by filling the pores with unctuous preparations; thereby counteracting the effects of wet by capillary attraction,—to which, by this means, it becomes impervious, and at the same time is not liable to unequal con-

traction and expansion. The blocks of wood are cut to the requisite form to fit very exactly in the external circular channel of the wheel, with the grain placed vertically throughout, forming a complete facing of wood. There are about from twenty-eight to thirty of these blocks round each wheel, where they are retained in their place by one or two bolts passing through each, the two sides of the channel having corresponding holes drilled through them for this purpose: the bolts are then well rivetted. After being so fitted, the wheel is turned in the usual manner. The wheel when finished has all the appearance of a common railway wheel, but with a rather deeper rim, the tyre faced with wood, and the flange of iron. Woods of various qualities may be used, whether hard or soft, requiring different chemical preparations according to their porosity, and in some instances requiring to be compressed.

The several advantages which this wheel possesses, are—

1. That the wood facing will wear a considerable time without requiring any repair.

2. That the wood can be re-faced, by turning it up again in the lathe, as practised with worn iron tyres.

3. That the tyre can be re-faced with wood at little expense, and at a far less loss of time than usual. In the operations of re-facing these wheels, or putting in new wood, the work can be performed without the labour and cost of removing the wheels from the axles, which in the keying and unkeying is known to be very troublesome.*

4. That, in regard to their working, it is the opinion of practical engineers, confirmed by actual experiment, that they will work smoother, easier, and, as some have expressed it, more "sweetly" than iron-tyred wheels; with the advantage of going well in wet weather, even upon inclines,—having sufficient adhesion to the rail, without dropping sand to assist them in this respect, as practised when iron wheels are used.

5. That another and very important result will be, that the rails themselves will suffer less wear by using this kind of wheel, and that the fastenings, sleepers, and blocks will receive considerably less injury, and thereby favour the laying of railroads on stone blocks, wherever they are considered to be most desirable.†

A metallic wheel with a wood-faced tyre, which is the principle of this construction, obviates most, if not all, the difficulties which have been experienced, whether in the use of wooden, cast iron, or even wrought iron wheels. Cast iron wheels may, indeed, now be considered not far short of being equal to wrought iron wheels, for safety and durability, with all the superiority of which the application is susceptible. They are also neither clumsy nor inelegant in form, and are capable of being made to any pattern, even for carriage wheels for common roads. It may, therefore, very possibly occur that they

* As in every thing affecting railways, it is a desideratum to decrease the expenses as much as possible, it may here he mentioned that three feet cast iron wheels, with wood-faced tyres and wrought iron axles complete, can be made much cheaper than the generality of wheels.

† On lines situated like the Greenwich Railway and the Blackwall Railway, wood-faced wheels would diminish much of the noise which at pesent is a source of general complaint.

will have the effect to bring cast iron wheels into as general use and as much reputation here as on the continent. This new construction and simple adoption of wood makes excellent driving wheels for locomotives; it may be readily stopped by using a cast iron brake, and does not undergo that wear which might be expected from the friction it then has on the rail. The wood, by use, becomes exceedingly close and firm, acquiring a surface not easily distinguishable from metal in appearance.

Civ. Eng. & Arch. Jour.

On the best method of Ventilating Coal Mines.

When two shafts, or pits, are sunk down to a coal mine, and a road cut through the mine from one to the other, the air that fills this road becomes rarified from the heat of the coal and the minerals surrounding—consequently, ascends one of the shafts, just like a chip of wood when immersed in water, and from the same cause—the shaft that is least in depth being that which the air generally ascends, from an obvious reason. Thus we have a process of ventilation going on, so long as the materials at the bottom remain at a greater degree of heat than the air at the surface of the earth—which current of air is more rapid the colder the air is at the surface (a well known fact amongst miners, that the current of air is greater in winter than summer;) the fire damp, or hydrogen gas, that issues out of the fissures of the coal, or minerals either above or below the coal, gets mixed with the agi tated air, and is carried up the shaft as fast as it evacuates itself, leaving the road between the shafts clear and safe. This is the principle on which ventilation is built. A fire placed at the bottom of one of these shafts would heat the surrounding materials also a considerable way up the shaft, and, as the air passed, part of it would be consumed by the fire; the other, and by far the greatest part, would become rarified by passing the fire and heated materials, and so ascend rapidly up the shaft—at the same time the surrounding air would rush down the other shaft to supply its place. Thus, a fire placed at the bottom of one of the shafts is only a more powerful substitute for the natural process; it is also evident, that the bottom of the shaft is the most proper place to put a fire—and those who doubt this have only to make the experiment to be convinced.

Having thus got a current of fresh air, we have only to direct its course through the various workings to carry away the gases as they evacuate themselves; but before I describe any method for doing this, let me show how the shafts are got down, also how the road is cut between them, which is generally a troublesome piece of work to manage. Shafts may sometimes be sunk to a considerable depth without experiencing any difficulty or danger from the damps or gases, but, when these present themselves, recourse must be had to some method for removing them away. The general way in this part of the country is to partition a small segment of the shaft off by means of boards, or, otherwise, to introduce pipes made of boards, of a foot by sixteen inches aperture, down the shaft, carrying the partition or

pipes along with them as they proceed in sinking, till they reach the mine; this partition, or the uppermost pipe, when pipes are used, is bent at the top, and carried in an horizontal direction to a little distance from the mouth of the shaft, where a chimney is erected, and a fire kindled at the bottom of it, similar to that mentioned by Mr. "X.," which causes a current of air to descend down the shaft and up the partition, or pipes, to the fire, then up the chimney, carrying away the damps or gases, as before described. Now, having a double road down the shaft for the ingress and egress of the air, answering for a time as two shafts, the cutting of the air or wind-road is then commenced. This road is cut double—that is, two roads are cut at the distance of about six feet from each other, and every three or four yards a cross-way is cut through between them—the pillar or coal left between them serving as a partition—the air coming down the shaft up one of these roads, turning through the opening or cross-way between them, then down the other road and up the partition, or pipes, to the fire. In this way the work proceeds till it reaches the other shaft, the miners always building one opening up as soon as they have cut another through. I may here remark, that while they are cutting the three or four yards, also the opening between, they are obliged either to let their candles remain at a distance behind them, or, otherwise, use the Davy lamp—the Davy lamp is generally used on this occasion.

The method of working coal mines are various, depending on the nature of the mines themselves, but more especially on the roof; there are, however, three essential points to be aimed at, the accomplishing of which depends on the skill of the manager. First—he must aim at getting as much of the mine out as possible, at the least expense, without injuring the workmen. Second—at keeping a good road free from wet and dirt, for the conveyance of the coals from all parts of the workings to the shaft. Third—at the greatest safety to the miners, from the roof and other things, but more especially from the damps or gases. He who has accomplished these deserves the name of manager. It may be thus conceived, that as the mines, and especially the roofs, vary, the methods of working and ventilating them must vary also—but all methods that have fallen under my observation bear some analogy to one another. By driving the roads double, as before described, the wagon roads may be cut with safety; but when the open, or wide working, as it is called, is commenced, it is then a little different—but these kind of workings should be so conducted as to have a current of air passing through them. Mining Jour.

Description of the Nonsuch Iron Passage Boat plying on the Limerick navigation, between that place and Killaloe. By Charles Wye Williams.

The attention of Mr. Williams having been attracted to the successful plan for the conveyance of passengers adopted on the Glasgow and Paisley Canal, where light sheet iron boats of great length travel

at a speed of nine miles an hour, he was induced to attempt the introduction of the same system on the Irish canals. A great difficulty, however, presented itself, as the locks there would only admit boats sixty feet long, which length was quite inadequate to the carrying out with advantage the principle involved in the long light Scotch boat. To overcome this difficulty, he constructed a sheet iron boat, eighty feet long, and six feet six inches wide at midships, having stem and stern ends (each ten feet long) attached by strong hinges to the body, and susceptible of being rapidly raised to a vertical position by means of winches; thus reducing the length to sixty feet when required to pass through a lock. It is evident that by this means there would be gained not merely the apparent additional buoyancy of ten feet at each end of the boat, which from the form would not be very effective, but in reality the buoyancy due to an addition of twenty feet of the midship section. The boat thus constructed has been found to answer perfectly; the buoyancy is equal to that of the Scotch boats of similar dimensions; no crankness or unsteadiness accrues when the ends are raised; it is capable of carrying sixty passengers, traveling at a speed of nine miles per hour, with the same power that was required to draw a sixty feet boat with a less load, and there is a much less action on the canal bank in consequence of the increased length, which at the same time imparts stiffness, and enables passengers to enter and leave the boat with safety. Considerable time is saved in passing the locks, by the opposition of the square end when the bow is raised; the boat may thus be run almost at full speed into the lock, and both ends being raised simultaneously, it is stopped much more easily than if the tapered ends were down. No provision is necessary for keeping the ends down, as the weight of the bow and steersman answers the purpose. This boat has been working without intermission for three years between Limerick and Killaloe, traversing twice daily a distance of fifteen miles, on a navigation of considerable intricacy, and passing eleven locks, without any accident having hitherto occurred.

Athenæum.

Mechanics' Register.

Accidents on Railways.

To the list we gave last week of railways, the miles run, and accidents which have occurred, we have to add the returns of the following :—

The Great Western has run 29,200,000 miles, carried 1,520,000 passengers, without any accident, fatal or otherwise, to a passenger, from its opening, 2 years and three months.

The Brandling Junction has run 92,876 miles, and carried 617,000 passengers without any fatal, and only two trifling accidents, neither of which prevented the parties from going about their usual business, in 12 months, to the 5th instant.

The Bolton and Leigh has run 223,480 miles; carried 674,870 passengers in 9¼ years, to the 15th September, with the following acci-

dents:—one passenger, attempting to get into the train when it was starting, got his foot bruised; another, who had got upon a wagon going off with the train, was thrown off and had his arm injured; a third had a slight contusion occasioned by a collision; and a fourth was killed by jumping off a train going at full speed, in consequence, as it was believed, of his being intoxicated. The only accidents attributable to the Railway are obviously the "slight contusion," and the injured arm.

The Dundee and Arbroath, opened October the 8th, 1838, (now 23 months) has, to the 1st September inst., carried 378,043 passengers, (the miles run not stated) with the following solitary accident, namely, the breaking of the leg of a passenger who had, contrary to the regulations, got into the luggage wagon.

The Arbroath and Forfar was opened January the 3rd, 1839, (now 20 months) and has run 59,000 miles, and carried 175,000 passengers, to September 10th. One accident only has happened; that is, a passenger broke his leg by jumping off the train while in motion.

Thus are added to our former list, from these five railways, only one of which is a large passenger line, 3,365,000 passengers carried, and on four only of the lines 29,575,000 miles run, without one fatal accident, and only two slight bruises fairly attributable to the Railways; for we repudiate all accidents which the drunken or headstrong ways of men, violating orders and rules, bring upon themselves. The account, therefore, will stand thus; about 256 millions of miles have been run, and 14 millions of persons carried, with only two fatal accidents from the railway system. Railway Mag.

Comparative Longevity of Miners.

The average age of those miners who died in Illogan, was forty-nine, and of those not miners, sixty-eight—making a difference of nineteen years. In Gamborne, the longevity of the miner was fifty-four years, whilst that of the man not employed in mines, was sixty—showing only a difference of six years. On this he should have to remark presently. The average of Gwennap was, of the miner, forty-six years, and of the non-miner sixty years—exhibiting a difference of fourteen years. But there was one other important fact, and to that he begged to direct the attention of the philanthropist. A mean per centage of seventeen of their mining population came to violent deaths in consequence of their employment. In Gwennap the deaths were one-sixth, but in Illogan he found it increase to 32 per cent.—so that it appeared that of the miners buried in Illogan, one-third had been the subjects of coroners' inquests. Mining Jour.

Early Settlement of America by Europeans.

A highly interesting discovery has been announced by the Danish geologist, Dr. Lund, to the Northern Archaiological Society, as made by him, while excavating in the neighbourhood of Bahia, in Brazil. This discovery began with the fragment of a flag stone, covered with

engraved Runic characters, but greatly injured. Having succeeded in decyphering several words, which he recognized as belonging to the Icelandish tongue, he extended his researches, and soon came upon the foundations of houses in hewn stone, bearing a strong architectural resemblance to the ruins existing in the northern parts of Norway, in Iceland, and in Greenland. Thus encouraged, he went resolutely on, and at length, after several days' digging, found the Scandinavian God of Thunder, Thor, with all his attributes—the hammer, gauntlets, and magic girdle. The Society has commissioned Professor Rafn, who first established, in an authentic manner, the existence of ancient relations between Iceland and Northern America, (anterior to the discovery of that part of the world by Columbus) to report on the subject of Dr. Lund's letter, and to publish his report, with a view to direct the attention of the learned to this very interesting discovery, which would seem to prove, that the ancients of the North had not only extended their marine voyages to Southern America, but even formed permanent establishment in that country.

Athenæum.

Improved Mode of Applying Water-power, patented by Captain George Davey.

The inventor claims the application of air jackets or chambers to a column of water, and the method of applying the power obtained by the pressure of the said column of water, through the medium of the compressed air contained in the said air jacket, whereby so great a quantity of air is driven into the working cylinder as to effect a great saving of water, which, in cases requiring a reservoir at a high level, is very important. An upright tube leads from the reservoir to the full extent of the fall of water; at each thirty feet this tube is surrounded by an air jacket, and three or four fine holes are made at the bottom of the tube, within the space covered by it. The lower part of the tube has a lateral connection with a small cylinder, with a double piston or dead boxes working therein. At the opposite side of this cylinder, there is a lateral connection with the working cylinder, that moves, by its piston and rod, the pump or engine. The water, passing from the reservoir, down the tube, forces a quantity of air from the air jackets, with the water, through the small cylinder (that has its double piston open) into the large working cylinder, by which means the piston of this cylinder is forced up; and the tappets on the rod of this piston are so arranged as to strike a lever connected with the rod of the double piston, which admits and shuts off the supply of water from the tube to the working cylinder. The piston of this cylinder being now forced up, the tappet on the rod causes the lever to put the double piston in such a position as to cut off the supply of water, until the water that is below the large working cylinder flows out into the waste, or discharging level. The piston with the rod, in descending, by its gravity, causes another tappet to strike the lever, and put the double piston or dead boxes, in the first position, in order to receive a fresh supply of compressed air and water, to set

the piston in the large cylinder again in motion, which communicates its power to a pump or engine. Civ. Eng. & Arch. Jour.

An Improved Apparatus for Regulating the Supply of Water to Steam-boilers, patented by James Knowles, *Little Bolton, Lancaster.*

Claims the use of a self-acting apparatus, the working parts of which are within the boiler, and communicate to the supply valve from without. A lever or rod is placed longitudinally on a fulcrum within the boiler, the longer end of which is an upright rod, with a float attached thereon, passing to the outside of the boiler; at the shorter end of the lever is another upright rod connected with the supply valve, working in a tube. As long as there is plenty of water in the boiler, the float will continue to press up the long end of the lever, and, consequently, cause the valve on the upright rod of the short end of the lever to press down on its bearing, and prevent the admission of water from the tank. But when the height of the water in the boiler diminishes, the float lowers with it, and thereby forces up the rod with the valve; thus admitting a further supply of water until the float again rises to close down the valve.—*Inventor's Advocate.*

Ibid.

Meteorological Observations for December, 1840.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	28	34	29.65	30.10	W.	Moderate.		Cloudy—clear.
☾	2	22	38	30.25	.25	S.E S.W	do.		Clear—do —do.
	3	29	44	.15	.15	W.	do.		Partially—do.—do.—do.
	4	27	28	.32	.35	N E.	do.		Cloudy—do.
	5	20	25	.16	.12	W.E.	do.	.63	Snow—cloudy,
	6	20	26	29.91	29 86	N.N.E.	Brisk.	1.05	Snow—do.
	7	19	29	30.07	30.12	N.W W.	Calm.		Clear—do.
☉	8	16	32	.13	.00	S W.	do.		Clear—cloudy.
	9	28	34	29.95	29.88	S.W.	do.		Clear—partially cloudy.
	10	33	46	.78	.75	W.N.W.	do.		Cloudy—clear.
	11	29	40	30.04	30.06	W.	do.		Clear—do.
	12	26	42	.10	.00	E.	do.	.78	Clear—rain.
	13	40	45	29.50	29.50	W.	Moderate.		Cloudy—clear.
	14	32	43	.60	.60	W.	do.		Clear—do.
	15	29	46	.60	.60	W.	do.		Hazy—do.
☽	16	38	34	.56	.56	W.N.	do.	.45	Lightly cloudy—snow.
	17	26	32	.60	.65	W.	do.		Clear—flying clouds.
	18	22	24	.80	.83	W.	Brisk.		Partially cloudy—do.—do.
	19	16	26	.95	30 00	W.	Moderate.		Clear—do.
	20	15	28	30.04	.10	W.	do.	.30	Clear—shower.
	21	21	30	.00	.02	W.	Brisk.		Clear—do.
	22	30	38	29 75	29.58	W.	do.		Cloudy—do.
⊗	23	20	28	30.01	30.00	W.	Moderate.		Clear—do.
	24	29	35	29.74	29.74	W.	do.		Cloudy—partially cloudy.
	25	12	22	.96	.96	W.	do.		Clear—do.
	26	24	38	.60	.50	E.	Calm.	.35	Snow—cloudy.
	27	28	24	.46	.46	W.	Moderate.		Cloudy—do.
	28	19	29	.85	.95	W.	do.		Clear—do.
	29	24	36	30.00	30.00	W.S.W.	do.		Cloudy—lightly do.
	30	31	38	.00	00	W.	do.		Cloudy—do.
☾	31	33	41	29 94	29.94	E.W.	do.		Cloudy—lightly do.
	Mean	25.35	34.06	29.87	29.89			3.58	

	Thermometer.	Barometer.
Maximum height during the month.	46.00 on 10th and 15th.	30.35 on the 4th.
Minimum " "	12.00 on the 25th.	29.46 " 24th.
Mean	29.705	29.88

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

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AND

MECHANICS' REGISTER.

MARCH, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM THIS JOURNAL VOL. X., 2ND SERIES, P. 371.]

PART SECOND.

In continuation of their report the committee on water power proceed to give deductions from the experiments, the particulars of which have been already stated. As a convenient division of the subject the experiments will be discussed under the heads of I. OVERSHOT WHEELS; II. UNDERSHOT WHEELS; III. BREAST WHEELS, and IV. GENERAL INFERENCES pertaining to the different modes of using water. To give authority to the conclusions of the committee the examination of the experiments will be minute, but for the benefit of those who wish rather to apply the results than to scan them closely, the THIRD PART of the report will contain rules founded on the general conclusions, and applicable directly to the questions occurring in the use of water as a moving power.

I. OVERSHOT WHEELS.

1. *The ratio of effect to power.*—It is important in determining the ratio of effect to power, under different circumstances, to employ all the experiments which the tables afford; on this account, as the results for wheel No. 1, when used as an overshot, were obtained with three different forms of gate, it will be necessary to show first that these forms were of equal, or nearly equal, efficiency. This will be done in the following tables, from one to five inclusive. In these tables the velocity of the wheel will be also entered for subsequent use and comparison.

The maximum result under each head is given in tables first, second, and third, as collected from tables A, B, and C., vol. viii, pp. 85, 88, 89.

The numbers in the first column refer to those of the experiments in column 1 of the general tables. The second column contains the head above the bottom of the gate, from 2 of the general tables. The third contains the head and fall, from 13. The fourth, the width of aperture, from 5. The fifth, the velocity of the wheel, from 11. The sixth, the ratio of effect to power, from 17. The next three columns, of tables first and third, contain, severally, remarks from the detailed tables, the mean ratio deduced from the sixth column, and the mean velocity of the wheel from the fifth. The column of remarks is not needed in the second table.

TABLE FIRST.

For the comparison of gate a with gates b and c. Collected from table A. (VOL. VIII. P. 85.)

No. of Experiment.	Head above gate.	Head and fall.	Aperture.	Velocity of wheel.	Ratio of effect to power.	Remarks.	Mean velocity of wheel.	Mean ratio of effect to power.
	feet.	feet.	inches.	feet.			feet.	
5	2.75	23.00	0.50	5.28	.829			
11	"	"	1.00	5.43	.839			
14	"	"	1.25	5.58	.834		5.43	.834
18	2.25	22.50	0.75	5.21	.820			
23	"	"	1.00	6.01	.835			
31	"	"	1.25	5.50	.837	Last experiment	5.57	.831
33	1.25	21.50	0.50	4.65	.839			
37	"	"	0.75	4.77	.850			
40	"	"	1.00	5.28	.850			
45	"	"	1.25	4.83	.845	Last experiment	4.88	.846
50	0.50	20.75	1.25	4.44	.872		4.44	.872
54	0.25	20.50	0.75	3.99	.810	Water too low		
56	"	"	1.00	3.76	.828	to fill aperture	3.87	.819

TABLE SECOND.

For the comparison of gates b with gate a and c. Collected from table B. (VOL. VIII. P. 88.)

No. of experiment.	Head above gate.	Head and fall.	Aperture.	Velocity of wheel.	Ratio of effect to power.	Mean velocity of wheel.	Mean ratio of effect to power.
	feet.	feet.	inches.	feet.		feet.	
3	2.75	23.00	0.75	7.52	.838		
8	"	"	1.00	7.66	.832	7.59	.835
15	1.25	21.50	1.00	5.28	.839	5.28	.839
18	0.75	21.00	1.25	5.50	.836	5.50	.836
22	0.50	20.75	1.25	4.65	.832	4.65	.832

TABLE THIRD.

For the comparison of gate c with gates a and b. Collected from table C. (Vol. viii. p. 89.)

No. of experiment.	Head above gate. feet.	Head and fall. feet.	Aperture. inches.	Velocity of wheel. feet	Ratio of effect to power.	Remarks.	Mean velocity of wheel. feet.	Mean ratio of effect to power.
2	2.75	23.00	1.00	5.35	.814			
18	"	"	"	6.62	.809	Air vents open.	5.99	.811
5	1.25	21.50	1.25	6.20	.845			
8	"	"	1.50	6.10	.838		6.15	.842
11	0.75	21.00	1.25	4.77	.842			
13	"	"	1.50	5.07	.841		4.92	.841
16	0.50	20.75	1.50	4.60	.831	Water too low to fill buckets.	4.60	.831

The following table contains the averages drawn from the three foregoing tables. In deducing the ratios of the mean velocities of the wheel, the least velocity in the table is taken as unity; and in comparing the mean ratios of effect to power the least ratio is also assumed as unity. The results with those heads only, which occur in all the three cases, are brought into comparison.

TABLE FOURTH.

Comparison of gates a, b, and c. Collected from tables First, Second, and Third.

	Nos. of experiments.	Head above gate. feet.	Velocity of wheel. feet.	Mean velocity of wheel. feet.	Ratio of velos. calling 4.44 unity.	Ratio of effect to power.	Mean ratio of effect to power.	Compar'n of ratios calling .811 unity.
Table first, gate *a*.	5, 11, 14	2.75	5.43			.834		
	33,37,40,45	1.25	4.88			.846		
	50	0.50	4.44	4.92	1.11	.872	.851	1.05
Table second, gate *b*.	3 & 8	2.75	7.59			.835		
	15	1.25	5.28			.839		
	22	0.50	4.65	5.84	1.31	.832	.835	1.03
Table third, gate *c*.	2 & 18	2.75	5.99			.811		
	5 & 8	1.25	6.15			.842		
	16	0.50	4.60	5.58	1.26	.831	.828	1.02

It appears from this comparison that the ratio of effect to power with the different gates, varies within the moderate limits of less than three per cent, being very little in favour of gate *a*. In fact the results are almost identical. This is not the case with the velocities, the consideration of which cannot, however, be conveniently introduced in this place.

The foregoing comparisons having been made with different widths of aperture, that is by taking a mean under each head, disregarding the variation in the quantity of water, they may be objected to as deduced from experiments not alike in every respect; for if the variation in the quantity of water produces any effect, these averages will be unequally altered by it. This reasoning is not applicable to any considerable degree, because the variation in the ratio of effect to power from the cause stated is small. To prove this position and to show the accordance of these mean results with single ones which are strictly alike in all the circumstances, the following table has been selected from tables first, second, and third. The arrangement of it is sufficiently explained by the headings of the different columns.

TABLE FIFTH.

Comparison of experiments similar in circumstances with gates a, b, and c.

Head above gate in feet.	Head and fall, in feet.	Width of aperture, in inches.	Gate *a*.		Gate *b*.		Gate *c*.		Ratio of velocities 4.44 being unity.			Ratios .814 unity.		
			Velocity of wheel in feet.	Ratio.	Velocity of wheel in feet.	Ratio.	Velocity of wheel in feet.	Ratio.	Gate *a*.	Gate *b*.	Gate *c*.	Gate *a*.	Gate *b*.	Gate *c*.
2.75	23.00	1.00	5.43	.839	7.66	.832	5.35	.814	1.22	1.73	1.20	1.03	1.02	1.00
1.25	21.50	1.00	5.28	.850	5.28	.839			1.19	1.19		1.04	1.03	
"	"	1.25	4.83	.845			6.20	.845	1.09		1.40	1.04		1.04
0.75	21.00	1.25			5.50	.836	4.77	.842		1.24	1.08		1.03	1.03
0.50	20.75	1.25	4.44	.872	4.65	.832			1.00	1.05		1.07	1.02	
								Mean	1.12	1.30	1.23	1.04	1.02	1.02

In these single results the ratios range from 1.00 to 1.07, the averages being almost exactly in accordance with the former conclusions. It follows, then, that *as far as regards the ratio of effect to power, gates a, b, and c, may be used in practice at the convenience of the mill-wright.*

We are now prepared to determine the mean ratio of effect to power in overshot wheel No. 1, twenty feet in diameter. This is done in the following table taken from tables first, second, and third, where the ratios under the different heads, with the three gates, are collected, and the means deduced.

TABLE SIXTH.

Overshot wheel No. 1.—*Ratios of effect to power under different heads.—The power being calculated on the head and fall.*

Head.	Mean ratio of effect to power, with gate			Mean.
	a.	*b.*	*c.*	
Feet.	Ratio.	Ratio.	Ratio.	Ratio.
2.75	.834	.835	.811	.823
2.25	.831			.831
1.25	.846	.839	.842	.842
0.75		.836	.841	.838
0.50	.872	.832	.831	.845
0.25	.819			

Omitting the last result in which the water was so low as to pass irregularly over the gate, the ratios vary from .823 to .845, or from 1 to 1.025. But two and a half per cent. of effect would, therefore, be lost in an overshot wheel of this size by varying the head from six inches to two feet nine inches. The lower heads give, of course, the best ratios, and leaving out of consideration the velocity of the wheel, are most advantageous.

The high results which these experiments prove may be obtained in practice from large overshot wheels, are worthy of special notice. With a head of .11 of the whole head and fall, (three inches in twenty-seven), which was the lowest used by Smeaton in his experiments, he obtained an effect of but .69 of the power. While in the experiments of the Committee with heads of 2.25 feet, for a head and fall of 22.50 feet, (.10 of the head and fall) and of 2.75 feet for 23.00, (.12 of the head and fall) we have ratios of .823 and .831.

It follows from these experiments that *in running a large overshot wheel to the best advantage, eighty-four per cent. of the power may be calculated upon for the effect.*

In regard to the effect of the quantity of water passing into the buckets of an overshot wheel with a given velocity, it is reasonable to conclude that under determinate circumstances it admits of being adjusted so as to produce a maximum effect. The annexed table will

show that in fact this is the case. It is selected from tables first and third, and contains the ratio of effect to power under given heads and openings.

TABLE SEVENTH.

Change of ratio by varying the quantity of water admitted to the buckets of wheel No. 1, overshot.

Width of aperture, in inches.	Ratio under head, in feet, of 2.75	2.25	1.25	1.25	0.75	Mean.
0.50	.829		.839			.834
0.75		.820	.850			.835
1.00	.839	.835	.850			.841
1.25	.834	.837	.845	.845	.842	.841
1.50				.838	.841	.839

The tendency to a maximum as the quantities are increased, by increasing the widths of the apertures, is not only seen in the separate columns but appears in the average, where it might be supposed that the introduction of the experiments with low heads would tend to raise the numbers so much as to make the small variation by quantity disappear.

The amount of increase, however, is shown to be too small to be regarded in practice, being probably less than one per cent. It may therefore be assumed *that within the limits of regular motion in the wheel, and waste from unduly filling the buckets, no diminution of effect will be experienced.*

In these experiments the areas of discharge for the water were varied from eight to twenty-four square inches, and the portion of the bucket which contained water to the whole capacity, in the case of the greatest proportion, was three tenths to one.

2. *The velocity of the wheel.*—The first question to be examined in this division of the subject is in reference to the relative velocities of the water and of the wheel, when the ratio of effect to power is a maximum. To determine which, the velocities of the water in the cases of maximum ratio given by the tables must be first ascertained. The velocity of efflux from the aperture in any particular case will be found by comparing the number of pounds of water discharged with the duration of the experiment. The discharge per second being thus known, in pounds, is converted into cubic feet and divided by the area of the aperture in square feet. In this way the numbers contained in in the third, eighth, and thirteenth columns of the annexed table, have

been found. For subsequent reference, a comparison has been made in this table of the theoretical discharges with those actually measured.

TABLE EIGHTH.

Quantities of water discharged per second, under the several heads, and with the gates *a*, *b*, and *c*, deduced from experiments giving the maximum ratio of effect to power. Collected from tables A, B, and C.

Overshot No. I.

Gate *a*.					Gate *b*.					Gate *c*.				
Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.	Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.	Head.	Width of aperture.	Velocity of discharge, per second.	Ratio of velocity to theoretical velocity.	Mean ratio.
feet.	in's.	feet.			feet.	in's.	feet.			feet.	in's.	feet.		
2.75	0.50	7.91	0.59		2.75	0.75	12.50	0.94		2.75	1.00	9.60	0.72	
"	1·00	7.23	0.54			1.00	12.20	0.92						
"	1.25	7.52	0.57	0.57					0.93					0.72
2.25	0.75	7.18	0.60											
"	1.00	7.15	0.59											
"	1.25	7.16	0.59	0.59										
1.25	0.50	6.53	0.73		1.25	1.00	8.00	0.89	0.89	1.25	1.25	6.57	0.73	0.73
"	0.75	5.51	0.61								1.50	6.57	0.73	
"	1.00	5.04	0.61		0.75	1.25	5.62	0.81	0.81	0.75	1.25	5.19	0.75	0.73
"	1.25	5.45	0.61	0.64							1.50	4.93	0.71	
0.50	1.25	4.06	0.72	0.72	0.50	1.25	4.48	0.79	0.79	0.50	1.50	3.99	0.70	0.70
0.25	0.75	3.54	0.88											
"	1.00	3.16	0.78	0.83										
Mean of 2.75,2.25,0.50,				0.63	Mean				0.85	Mean				0.72

A comparison of the quantities actually discharged with the theoretical discharges, shows a difficulty in obtaining the actual velocity of the efflux. The coefficient for the contraction of the vein by gate *a*, is very nearly that for a thin plate, while those for *b* and *c* show that they have acted in part as adjutages in modifying the discharge, although it is a fact that experiments made when the aperture was evidently filled were rejected. While the quantity of discharge is thus increased, the velocity of efflux is actually diminished. If then the impulse of the water and not the quantity delivered is the determining circumstance of the velocity of the wheel, and the retardation of the water should be considerable, the fact will appear in the sequel.

After leaving the aperture, the water is accelerated in falling until it strikes the wheel. To know where to assume the average point of impact it will be necessary to consider the motion of the wheel. The

water on entering an elbow bucket will first strike against the arm, then as the wheel revolves will meet the bottom of the bucket, or soling of the wheel, and so on until the next bucket present itself. After the water has struck the arm of the bucket it falls to the bottom, not having imparted all its velocity to the wheel by the impact. As the bucket fills, the distance through which the water falls will diminish.

The following approximate table has been calculated from the actual quantities of discharge per second under the different heads, and with different apertures, the known velocity and particular construction of this wheel.

TABLE NINTH.

Showing the relative proportions of the part of each bucket, which contained water, to the whole capacity of the bucket.

	Head.	Width of aperture.	Discharge per second.	Velocity of wheel per second	Time of passage of bucket.	Water received by bucket.	Portion of entire bucket w'h. is filled.	Mean ratio.
	feet.	inches.	cubic feet.	feet.	seconds.	cubic feet.	Ratio.	
Gate *a*, elbow buckets.	2.75	0.50	0.438	5.28	0.24	0.105	0.14	
	"	1.00	0.800	5.43	0.23	0.184	0.25	
	"	1.25	1.040	5.58	0.22	0.229	0.31	0.23
	2.25	0.75	0.597	5.21	0.24	0.143	0.19	
	"	1.00	0.794	6.01	0.21	0.167	0.23	
	"	1.25	0.991	5.50	0.23	0.228	0.31	0.24
	1.25	0.50	0.362	4.65	0.27	0.097	0.13	
	"	0.75	0.458	4.77	0.26	0.119	0.16	
	"	1.00	0.611	5.28	0.24	0.146	0.20	
	"	1.25	0.755	4.83	0.26	0.196	0.27	0.19
	0.50	1.25	0.564	4.44	0.28	0.158	0.22	0.22
	0.25	0.75	0.294	3.99	0.31	0.091	0.12	
	"	1.00	0.350	3.76	0.33	0.115	0.16	0.14
Gate *b*, elbow buckets.	2.75	0.75	1.040	7.52	0.16	0.166	0.23	
	"	1.00	1.360	7.66	0.16	0.218	0.30	0.26
	1.25	1.00	0.887	5.28	0.24	0.213	0.29	0.29
	0.75	1.25	0.777	5.50	0.23	0.179	0.24	0.24
	0.50	1.25	0.619	4.65	0.27	0.167	0.23	0.23
Gate *c*, elbow buckets.	2.75	1.00	1.088	6.85	0.18	0.196	0.27	
	"	1.25	1.320	6.62	0.19	0.251	0.34	0.30
	1.25	1.25	0.870	5.66	0.22	0.191	0.26	0.26
	0.75	1.50	0.856	5.66	0.22	0.188	0.26	0.26
	0.50	1.50	0.667	4.65	0.27	0.180	0.25	
	"	2.00	0.736	5.21	0.24	0.176	0.24	0.24
Gate *c*, centre buckets.	2.75	1.00	1.073	5.35	0.23	0.247	0.34	0.34
	1.25	1.25	0.909	6.20	0.20	0.182	0.25	
	"	1.50	1.090	6.10	0.20	0.218	0.30	0.27
	0.75	1.25	0.717	4.77	0.26	0.186	0.25	
	"	1.50	0.818	5.07	0.25	0.204	0.28	0.26
	0.50	1.50	0.661	4.60	0.27	0.178	0.24	0.24

From this table it appears that at the higher heads, 2.75 and 2.25 feet, the portion of the elbow buckets which was filled was .25 and at low heads .17. From these data it may be shown that if the water

were distributed with a surface parallel to the soling, the depth in the first case would have been .11 of a foot, and in the second .07. The water flowing towards the lower part of the bucket, ever occupied an average depth equal to that calculated, and the depth of the bucket being .60 ft., no sensible error will arise by taking .15 ft. from the distance between the aperture and the bottom of the bucket, in the higher heads, and .10 ft. in the lower ones to obtain the distance through which the water was accelerated after leaving the aperture.*

The same table shows that the elbow buckets used by the committee had a sufficient breadth of throat to receive the water without difficulty. The portion of the centre buckets occupied being, at a mean, very little greater than that of the elbow buckets.

In the table which follows, the approximation just referred to is applied. The head corresponding in theory, to the velocity of efflux from the aperture or virtual head, is first obtained. To this is added, for the higher heads, the distance from the aperture to the bottom of the bucket, obtained from tables A, B, or C, less .15, and for the lower the same distance less .10 ft. The velocity corresponding to the sum is that with which the water struck the wheel. The velocity of the wheel at the maximum is transferred from the tables first, second, and third.

TABLE TENTH.

Comparison of the velocity with which the water strikes the wheel with the velocity of the wheel.

Overshot No. I.

	Head.	Velocity of Water.	Virtual head.	Virtual head tog'th'r with constant.	Velocity of impact.	Velocity of wheel.	Ratios.	Mean ratio.
	feet.	feet.	feet.	feet.	feet.	feet.		
Gate a.	2.75	7.55	0.885	1.585	10.02	5.43	0.54	
	2.25	7.17	0.798	1.498	9.78	5.57	0.57	
	1.25	5.50	0.469	1.219	8.74	4.88	0.56	
	0.50	4.06	0.256	1.006	8.02	4.44	0.55	
	0.25	3.35	0.176	0.924	7.69	3.87	0.50	0.54
Gate b.	2.75	12.35	2.368	3.068	14.03	7.59	0.54	
	1.25	8.00	0.978	1.728	10.50	5.22	0.50	
	0.75	5.62	0.490	1.240	8.90	5.50	0.62	
	0.50	4.48	0.311	1.061	8.26	4.65	0.56	0.55
Gate c.	2.75	9.60	1.431	2.131	11.71	5.35	0.46	
	1.25	6.57	0.670	1.420	9.54	6.15	0.64	
	0.75	5.06	0.397	1.167	8.66	4.92	0.57	
	0.50	3.99	0.247	0.997	7.98	4.60	0.57	0.56

* This correction is not important, but as the calculations pertaining to it serve to show an important fact in regard to the due proportions of the buckets, it has been deemed worth while to produce them, and to show their application. The ratio of the velocity of the wheel to that of the water would be affected but .02 in .52, by assuming the bottom of the bucket as the place of impact.

The table just given developes this fact in regard to *the velocity of the overshot wheel,* namely, that it *bears a constant ratio, for maximum effects, to that of the water, this ratio being at a mean about .55, or nine-sixteenths.*

The ratios for both gates *b* and *c*, exceeding that for *a*, confirms, in a degree, the remark before made, that the velocity is checked in flowing from them.

The correspondence just shown, renders the determination of the head for an overshot wheel, to suit a fixed velocity, very simple. The depth of the bucket being the only variable quantity.

[TO BE CONTINUED.]

Blasting Rocks under Water by means of the Galvanic Battery.

At page 221, vol. xii, of the last series of this Journal, we published an article by Professor Hare, describing an apparatus for the blasting of rocks by means of galvanic ignition; and it will be seen, by the subjoined letter, that Captain Paris, a well known engineer and architect, of Boston, has applied the proposed means with perfect success, in blasting rocks under water. In the article by Dr. Hare, Mr. Moses Shaw, of Nova Scotia, is mentioned as having first suggested the idea of igniting the powder in blasting rocks, by the aid of the electric fluid. That gentleman had pursued the subject with much persevering industry, contending, at the same time, against pecuniary difficulties, and a want of those resources which science alone can supply, in the prosecution of such undertakings. He well merits, however, to have his name associated with those who have brought the matter to a successful issue.

EDITOR.

DEAR SIR,—Knowing the great interest you have always manifested in all engineering operations connected with the construction of public works, it affords me pleasure to communicate to you an account of the transactions within the past summer at this Navy-Yard, in blasting rocks under water, by means of the galvanic battery.

The application of this means to purposes of blasting, is somewhat novel, as you are well aware, and the account of Colonel Pasley's experiments in England has given to the public the first notice of its being thus employed. Since the blowing up of the wreck of the Royal George, it has been successfully used in England in blasting rocks and clearing harbors, rivers, &c. from obstructions: it bids fair to entirely supercede the old methods of blasting, both in civil and military operations, especially in the latter, where it becomes a tremendous agent for the instantaneous explosion of mines, &c.

In the detailed accounts of the experiments tried by Col. Pasley, it appears that at first, many difficulties were encountered; and the numerous failures seemed to forbid any hope of success in large operations, although the result of those on a smaller scale generally proved satisfactory. Perseverance, however, enabled the operators, after many trials, to render the explosion of the charge under water, as certain as by the ordinary methods on dry land; and the subsequent success in blowing up sunken wrecks, &c. at the bottom of the Medway river, and at Spithead, proved the utility of the means and amply compensated for the labour and expense incurred in the first attempts.

Our operations during the past season were confined chiefly to the construction of quay walls and the foundations of two launching ways, the whole of which were built of stone. The character of the bottom of the river where the work was laid, rendered blasting or other means necessary, before a proper surface for the foundation could be obtained; it was desirable to give it a slight inclination inwards, so that the face of each course of stone should lie somewhat higher than the inside, thus preserving a proper batter of the walls and rendering them perfectly secure. This bottom is a hard slate rock, and, with the exception of some level portions, extremely uneven, with slopes of almost every grade, generally in an outward direction from the shore. The depth of water in the line of the walls varies from fifteen to twenty feet at low water, and from twenty-five to thirty below the high tides. This depth of water added to a strong and variable current, caused me to anticipate much difficulty and great expense in all operations below its surface.

But we were fortunately provided with a fine diving apparatus, consisting of a cast iron diving bell and a powerful air pump attached. This apparatus was worked from a vessel of strong construction and light draught, fitted expressly for the purpose. A system of signals and messengers was established for communication between the workmen in the bell and those on board the vessel; by these means every want was speedily made known and answered. Four workmen, divided in two gangs were employed for working in the bell, which made four descents per day, occupying at each time two and a half hours, the two gangs alternately relieving each other. The bell was amply supplied with a constant stream of fresh air, and but two or three inches of water remained in it at its greatest depth, so that the men worked in a comfortable state, perfectly dry and with no more difficulty of respiration than on dry land.

In deciding upon the best means for preparing the bottom for the reception of the foundation of the walls, I was greatly at loss which to adopt. It appeared to me that in adopting the method practised

by Col. Pasley, great expense and difficulty would be incurred; and as it did not appear that this method had been employed in blasting the solid rock at the bottom of a river, in any of his experiments, I was somewhat apprehensive of its utility for operations of this kind, and whether the cost would justify the trial. In order to satisfy myself with regard to the expense of an experiment with the galvanic battery, I applied to Mr. Daniel Davis, Jr., philosophical instrument maker, of Boston, for the necessary information, when I was convinced that a very trifling expense would procure such a trial as would satisfactorily decide the merits of the apparatus. Mr. Davis kindly assisted me in making the experiments which were tried at the Navy Yard at Charlestown, and I had the pleasure of witnessing the most satisfactory results, and without hesitation determined to apply the means to the work in hand.

The galvanic battery which was constructed by Mr. Davis, was one of Doct. Hare's invention, of Philadelphia. It consists of two vessels or jars, each formed by two concentric cylinders of copper, admitting of a cylinder of zinc between. Two copper wires termed the conducting wires formed the medium by which the electrical fluid was communicated to the charge from the battery. These wires were closely wound with thread in order to prevent their coming in contact with each other, and both tightly covered with tape, and afterwards served round with twine, thus forming a single coil. At each extremity of the coil the wires were separated for a few inches like a fork. This form of the galvanic battery, termed by Doct. Hare, the "Calorimoter," is the most simple and portable of any that I have seen; its power for blasting gunpowder may be increased to any required degree, either by enlarging the size of the jars or increasing their number. We had, in addition to this apparatus, a simple contrivance for proving the charges of powder, which is termed the "Electrometer."

The charges used in blasting consisted of various quantities of gunpowder, according to the effect required, from four ounces to a pound. They were enclosed in perfectly air tight tin cannisters, the smallest being an inch and a quarter in diameter, and the diameter of the largest about two inches; the lengths of the cannisters were eight or nine inches. Two copper wires were introduced into the cannister about half way down, with the extremities connected by a fine platinum wire; the other ends of the wires projected twenty or twenty-five inches beyond the mouth of the cannister, which after being filled with powder was closed and effectually secured with a water-proof composition. It will be observed in thus preparing the charges that

the whole is completely air and water tight, and that no vent to the powder remains, an advantage of which I shall further speak.

The operation of blasting is carried on in the following manner: The hole in the rock for the reception of the charge is drilled to a proper depth by the workmen in the bell; the cannister is then inserted with the ends of the copper wires extending outside of the hole, which is then filled up or tamped with coarse sand. The ends of the conducting wires are then connected by means of clamps to the wires leading from the charge; the other end of the coil is then led up, as the bell is hoisted to the surface, to the battery, which in all our experiments was placed on a floating stage directly over the charge. The jars forming the battery are brought near each other, and their whole power concentrated by connecting them together with a short copper wire; the end of one of the conducting wires is then brought in contact with one pole of the battery, and the end of the remaining wire similarly disposed with the other pole, when the explosion instantly follows by the platinum wire in the charge becoming intensely heated as the electrical current passes through the conducting wires.

We made during the past season nine blasts, with but one failure, which was caused by the platinum wire in the charge becoming accidentally broken, so as to render the electrical circle incomplete; this probably occurred in tamping, an operation which must be conducted with care, as this accident is most liable to be incurred, of all others, owing to the extreme delicacy of the wire. The object of the electrometer is to detect whether this has taken place before the charge is inserted in the rock, and may always be ascertained by a simple trial.

It must be obvious to every one, at all experienced in blasting rocks, that this method has advantages in many respects over the old methods, both under and out of water. The danger of accidental explosions is entirely prevented; these occur for the most part in the old practice by carelessness, while in this, great care and nicety are required to produce the explosion. There is very little time required in charging, as the cannister is simply inserted in the hole and tamped with sand; the whole time occupied in this operation and making the connection with the conducting wires in the present cases rarely exceeded twenty minutes. There is great expense and trouble saved in the absence of the train or fuse, which was indispensable in the old methods, especially under water, where was always required a water-tight hose or tube leading to the surface, which was always destroyed by the explosion. Here nothing is lost or injured except the cannister containing the charge. The explosion of the charge is

reduced almost to certainty, and should cases of failure occur, it can be approached with safety, without the suspicion that fire may be near it. The most important advantage in an economical view, is that the effect of the charges is much greater than in the old way, in consequence of there being no vent-hole; the whole explosive force of the powder is thus gained, while by the old methods much of it is lost. Our smallest charges displaced a much greater quantity of rock than the same amount of powder by the old means, which we had opportunities of experiencing. With these advantages, this method of blasting places in our hands the most ample means of clearing harbours and rivers of rocks, &c. in any reasonable depth of water.

In using Doct. Hare's apparatus, it appeared that an important advantage was gained over that of Professor Daniell's, employed by Col. Pasley, inasmuch as a very troublesome arrangement, indispensable in the latter, was avoided. This consisted in not being obliged to insulate the conducting wires from the water, as in such a case the connection of the conducting wires with the charge must be made before the cannisters are placed in the rock; every portion, then, of the wires where the connection is made, must be covered with the water-proof composition. By Professor Daniell's apparatus, it appeared that water was a conductor, thus destroying the electrical circle, if any part of the conducting wires came in contact with it.

Though Doct. Hare's battery was known to Col. Pasley, it was not adopted in his experiments, the reason assigned being that "it did not appear that he had ever used it under water."

I have the honour, Sir, to be,

Your obedient servant,

ALEXANDER PARIS, Civil Engineer.

COL. S. THAYER, Boston.

Navy Yard, Portsmouth, N. H., Nov. 9, 1840.

An Account of the Establishment for the Manufacture of White Lead, from the Pulpy Oxide of Lead, under the Patent granted to Mr. G. F. Hagner.

At page 274, of the last volume, we published an article "On the manufacture of white lead from the pulpy oxide prepared by trituration," in which we intimated that we expected to obtain some further information upon this subject. The subjoined letter, from a gentleman who was a principal in the undertaking, affords this information; and the character of the writer for intelligence and integrity, is too well known to be strengthened by any thing that we could say. Patents have been obtained, within a few years, by persons

who appeared to consider the triturating process itself to be new, as described by them; the facts which we have before published, together with those detailed in the accompanying letter, must put this question at rest; and it will also appear that the proceeding in some other particulars was substantially the same with such as have been sinee claimed by others.

To the Editor of the Journal of the Franklin Institute.

Shamokin, 12th Month, 21st, 1840.

Respected friend.—A succession of engagements have prevented an earlier reply to the inquiries made by thee respecting what I know relative to the discovery of making white lead by attrition, I now offer, from recollection, the following facts, my papers relating to them, being in Philadelphia.

I spent the winter of 1817–18, in London, and there met, for the first time, with Geo. F. Hagner, of the county of Philadelphia. He informed me that he had discovered a method of making white lead by attrition, that he had obtained a patent for his discovery in the United States, and that he had come to Europe for the purpose of procuring patents in such kingdoms as he might think it his interest so to do; my belief is that he entered caveats, or took out patents, for England, Scotland, and Ireland. In the following spring, he went to the continent, and remained there for some time.

About this period, Jos. Richards, who had, for several years, been engaged in manufacturing white lead, by the old process, built a mill, and put up machinery, at the Falls of Schuylkill, for making lead by attrition; whether the plan pursued by him was identically the same as that patented and claimed by G. F. Hagner, I am unable to say, never having seen his works, the water power of his mill being destroyed, in common with all other power, at the Falls, by the dam at Fairmount. I did, however, see a portion of his machinery, which differed materially from that used and approved by G. F. Hagner.

Soon after I returned home from Europe, I met with G. F. Hagner, and was induced to invest a considerable sum of money in manufacturing white lead by his process. We commenced in the spring of 1820, in a small mill, on the west bank of the Schuylkill, below Flat Rock, but soon after removed to a mill built near the locks on the canal, at Manayunk. The first process was to melt the pig lead, and reduce it into very fine particles, as fine as gunpowder. The process by which this was done, was cheap and rapid, but as G. F. Hagner never patented it, and kept it a secret from the workmen, I do not feel at liberty to describe it; I may, however, mention that the lead was not dropped into water, as stated in an article of the September No. of

the Journal. The granulated lead was put into large cylinders made of wood, and lined with sheet lead. These cylinders were about six feet long, by four feet six inches wide at one end, and three feet at the other. The small end was open. They revolved on an axle passing through the centre. With the lead was put vinegar, or water, and as the liquid became thick with the white oxide, it was taken out and fresh lead and vinegar added. The white oxide was allowed to settle; was washed to rid it of the acid, then dried, and ground in oil, as usual. The article, as thus manufactured, had great specific gravity, covered well, and resisted the effects of sun and weather better than white lead made by the old process. It dried quickly, without the use of litharge, it was well adapted for outside use, but not for the interior of houses, as it became very yellow in confined rooms; on account of this property it was not liked, and we expended considerable money to overcome this difficulty. In the course of our experiments I deemed it prudent to consult our late worthy and esteemed friend, Wm. H. Keating, then Professor of chemistry, in the Faculty of Arts, in the University of Pennsylvania, who analyzed some of our white lead, and gave us his opinion respecting it. He had in his possession, at that period, an apparatus that had been used on the Brandywine, by a friend of his, in trying a set of experiments to produce the same result that we were trying to effect. This apparatus he lent us, and we used it at Manayunk.

After having spent many months, and undergone much labour of body and mind, and having also expended a considerable sum of money, we believed that we had arrived at a mode by which we could make a perfect article; but as we had not room enough to operate in the part of the mill we occupied, I sold out at Manayunk, and erected buildings at Norristown, adapted to our purpose, in which we could make two tons of white lead in every twenty-four hours.

In this new establishment, we put up the large cylinders before described, but did not depend alone on the white oxide made in them; all that was made in these was used by us; but our principal dependence was upon litharge. The litharge, or the white pulpy oxide, either together or separate, was run through a pair of mill stones, with distilled vinegar, and in this liquid state the ground material was passed through a set of tubes or cylinders connected by copper pipes. These cylinders were air tight, lay on their sides, and were fitted up with dashers much like a common butter churn. With the litharge and vinegar, was forced into the cylinder a large quantity of carbonic acid gas. These materials passed through eight cylinders with dashers, and into a ninth, without dashers; from this last cylinder the gas passed into the open air through a high copper tube, and the

liquid into tubs placed on the floor, so as to admit of the settling of the lead; these tubs were connected with tubes which allowed the vinegar to pass into a reservoir, to be used over again.

The lead was then washed to get clear of the acid, dryed, and ground, as usual. The white lead thus made, was a perfectly carbonated article, very fine and white. Its specific gravity was less than that of the best white lead made on the old plan, and hence there arose an opinion in the mind of the consumer, that it was adulterated. At the exhibition of the Franklin Institute, in the year 1826, I obtained the premium, in competition with the best lead there. The article we made was beautiful, and the arrangement as complete as any I ever saw.

In justice to Philip Mayer, a German, of considerable chemical and mechanical knowledge, I should say, we had his aid in this establishment.

In conclusion, I may state, we had the result of upwards of two thousand experiments, tried during a period of five years, and that finally we succeeded, so far as to produce a truly excellent article. To give a description of our numerous experiments, would fill a number of the Journal.

In this letter, I have endeavoured to give the kind of information which I believe was desired by thee; if not, please inform me, and I shall be glad to afford thee any other in my power.

I am, very respectfully, thy friend,

SAMUEL R. WOOD.

In the foregoing letter, the writer mentions that the lead was granulated by a process which Mr. Hagner did not communicate to his workmen, and which he, therefore, does not feel himself authorized to disclose; we, however, are at liberty to offer our conjectures respecting the manner in which the granulation spoken of was effected, and which, we suppose, was upon a principle well understood by chemists, and others. We apprehend that the lead, in a fused state, was submitted to continued agitation in a revolving iron cylinder, or other suitable vessel, the agitation being continued until the metal had set, or lost its fluidity, when it would be found in the state of fine grains, as above described.

On Indigo.

Part 1*st. The constituents of ordinary Indigo.*—Of all colouring materials employed in dyeing and printing on vegetable or animal fibre, indigo claims pre-eminent rank, whether in regard to its beauty,

durability, or the variety of methods of application, and indeed in respect to its fastness or permanency, it is unequalled by many, and scarcely excelled by any of the colours derived from the mineral kingdom, when exposed to ordinary atmospheric agents. These considerations, and the fact of its very extended employment in colouring processes, point it out as worthy of peculiar attention and close investigation, in order to a thorough knowledge of its characteristic properties, and chemical relations, which, although not sufficiently examined, have nevertheless been rendered more intelligible, chiefly by the experiments of Berzelius.

In the state in which it occurs in commerce, it has long been known to be composed of a blue colouring matter, with various other ingredients, which were very imperfectly understood, until Berzelius proved that it contained four principal ingredients, together with small quantities of others. These are indigo-gluten, indigo-brown, indigo-red, and indigo-blue.

1. Indigo-gluten is obtained from the indigo of commerce, by treating it in fine powder with dilute sulphuric acid, which extracts it, together with salts of lime and magnesia. The insoluble remainder is boiled several times with water, which takes up more gluten than the acid water. The solution is saturated by carbonate of lime (chalk or marble), filtered, evaporated to dryness, and treated with alcohol. By evaporating the tincture to dryness, the gluten remains as a yellowish, or yellowish brown, transparent and shining varnish. In its behaviour towards reagents it resembles gluten, differing from it by its solubility in water, and its want of adhesiveness; it differs from vegetable albumen by its solubility in alcohol, and its not coagulating by ebullition.

2. Indigo-brown is obtained by treating the insoluble remainder after extracting the gluten by a concentrated solution of caustic potassa, with the assistance of warmth. The mass becomes instantly black, and swells up to a porous paste, in proportion as the brown colour dissolves. It is diluted and filtered, and the filter slightly washed. The solution neutralized, and then acidulated by sulphuric acid, suffers the brown to precipitate, which may then be washed. As it still contains a portion of indigo blue, it is dissolved in carbonate of ammonia, evaporated to dryness, dissolved in a little water and filtered, by which operation, the blue, with a portion of the brown, remains on the filter. It is exceedingly difficult to obtain it perfectly free from other substances, so that it cannot be said that we understand the nature of the pure brown substance. In its purest form it is a transparent, shining, brown varnish, slightly soluble in water, with neither an alkaline nor acid reaction. It combines eagerly with

acids, forming combinations, which are difficultly soluble in water. It unites so powerfully with alkalies, that the resulting compounds, although soluble in water, give no alkaline reaction with reddened litmus paper.

3. Indigo-red is obtained by boiling the remainder from the preceding operations, with alcohol of 0.83. Being difficultly soluble in alcohol, it is requisite to submit the residue to repeated boilings. After some time, the red solution passing through the filter, assumes a blue colour, from the presence of indigo blue. When the alcoholic liquid is concentrated by distillation, a blackish brown powder deposites, which, separated by filtration and washing, is indigo-red. By solution in alcohol or ether, and spontaneous evaporation, it remains as a dark red powder. It is insoluble in water, alkali, or dilute acid. Concentrated sulphuric acid dissolves it with a dark yellow colour, and if wool be placed in the diluted solution for several hours, it decolourises it, while the wool receives a colour varying from a yellowish brown to red. Chlorine water renders indigo-red yellow and soft, like wax, but after exposure to air, it assumes its original character.

4. After the three preceding substancs are separated, the indigo-blue which remains is not absolutely pure, but may be rendered so by the following treatment. It is mingled with quick lime, (about twice the weight of the crude indigo) which is slacked to a powder immediately before its employment, put into a flask capable of containing one hundred and fifty times as much water as indigo, the flask is nearly filled with boiling water, and shaken. Sulphate of iron (copperas) is added (about two-thirds the weight of the lime) in fine powder, or dissolved in a little boiling water, the flask corked tightly, and well shaken. It is suffered to stand a few hours in a warm place, when the liquid assumes a lemon or dark yellow colour, in proportion to its concentration. As soon as the liquid has settled, the clearer portions are drawn off, and the remainder filtered through paper. The indigo blue, separating from the liquid when in contact with the atmosphere, carries down with it a portion of the foreign substances, an inconvenience easily obviated, by pouring the yellow liquid into dilute muriatic acid, which retains them in solution. The precipitate is well shaken until it assumes a full blue colour, then thrown on a filter and thoroughly washed. After it becomes dry, it is no longer of a blue colour, but has a shade of purple, and by friction exhibits a metallic lustre resembling that of copper. Hence the strength of the purple indicates, in some measure, the amount of blue in raw indigo.

Indigo-blue, in its pure form, has neither taste nor smell, exhibits

neither the reaction of an acid nor a base, and in short, is one of the most indifferent substances in its chemical relations. It burns, with difficulty, in the open air, with much smoke, and leaves a charcoal which burns with difficulty. If heated in a close vessel, without the access of air, it is converted into a purple vapour, which is gasiform indigo-blue, and condenses on the cooler portions of the vessel in crystalline scales, of a purple colour and metallic lustre. A considerable quantity of the blue is decomposed by the operation. The same crystals may be obtained from commercial indigo, but they are rendered impure by the sublimation of indigo-red. To perform the operation on a small scale, it is only necessary to place a cone of strong brown paper over a slightly concave tin dish of two or three inches diameter, and heat the latter over a lamp until the paper begins to brown, which heat is maintained until the greater part of the indigo is sublimed. The interior of the cone will be thickly coated with crystals, which can be purified, if requisite, by repeated boiling in fine powder with alcohol, which removes the red.

Indigo-blue is insoluble in water, alcohol, ether, olive oil, or spirits of turpentine. It is not affected by dilute acids, nor caustic alkalies. Chlorine instantly decomposes it, and renders it yellow. It is readily deoxidized by substances which have a strong affinity for oxygen, provided an alkali or alkaline earth be present, in which case the reduced indigo combines with the strong base. It is dissolved by concentrated sulphuric acid, but changed in a very remarkable manner. It is farther decomposed by nitric acid, giving rise to new and singular products. These chemical relations of indigo will occupy our attention in the succeeding part of the essay.

It appears, therefore, from the preceding, that there are four principal organic constituents in indigo, beside others in smaller quantity. Of these, the blue rarely attains 50 per cent. of the weight of the raw material; the red and brown are each present in larger proportion than the gluten. Beside these, there are mineral substances contained in it, either accidental or adulterations, such as silica, lime, magnesia, oxide of iron, alumina, potassa, and a little phosphoric acid.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

(Translated from the German, by L. Klein, Civil Engineer.)

Letter VIII.

(Continued from page 82.)

6. *Cost of Running Steamboats.*

The expenses incident to the management of steamboats, consists in the salaries and wages of the individuals employed, the cost of fuel (wood), of the victuals for the cabin passengers and crew, and in the cost of repairs of the boat and engines.

I have mentioned, under No. 4, the extraordinary rise in wages, which took place during the last few years; the cause of it lies principally in the considerably increased number of steamboats, and the want of useful individuals, as also in the universal rise of prices of all articles in the United States. The payments to the officers and crew of the "Franklin," are, per month, as follows, viz:

1 Captain and 2 clerks,	$200
2 pilots,	200
2 engineers and 2 assistants,	250
2 mates,	80
1 carpenter,	30
2 cooks,	80
1 steward and 6 waiters,	140
1 chambermaid,	20
10 firemen,	200
6 common labourers,	120
38 persons, total,	$1320
Add for 785 cords of wood, and a few tons of coal,	1775
" provisions for 62 cabin passengers, and 38 men belonging to the boat, together for 100 persons,	1400
Total expenses, without repairs,	$4495

or nearly forty-five hundred dollars per month. During nine months in the year, the boat makes daily, a trip of one hundred and fifty miles, together, forty thousand five hundred miles per year; during the remaining three months, she is laid by, on account of the low

stage of the water in the river. She then is newly caulked, painted, and receives all the necessary repairs. The latter amount, with a new boat of this class, to not more than three thousand dollars in the first year, to which an amount has to be added for general depreciation, which is considerable. The timber of which the vessels are constructed here, is grown so fast, under a warm climate, that a vessel seldom lasts over six or seven years; but steamboats of the first class are used only four years, and then sold; the new proprietor continues to employ the boat for a few years longer, but her voyages are not so certain. Twenty-five per cent. of the original cost must therefore be taken as the amount for depreciation, in the first year, which makes seventy-five hundred dollars for the steamboat "Franklin;" at the end of the first year the value of the boat is therefore only twenty-two thousand five hundred dollars. In the second year, twenty-five per cent. of these twenty-two thousand five hundred dollars, or five thousand six hundred and twenty-five dollars are taken for the general depreciation; but the repairs in the second year amount to so much more, that their cost, together with the sum for general depreciation, is again equal to ten thousand five hundred dollars, as in the first year. The same calculation is applicable for the third and fourth year, after which, the value of the boat remains only nine thousand four hundred and ninety-two dollars, for which amount it is then sold.

We have, therefore, the following, as the yearly expenses for the steamboat "Franklin."

Current expenses during 9 months running time,	$ 40,500
During the remaining 3 months, the salary of the Captain and clerks, who remain on the boat, while the others are dismissed, amounts to	1,000
Repairs and general depreciation, - -	10,500
Insurance, 7 to 9 per cent. on three-fourths of the value, to which steamboats can only be insured,	1,350
Sundry small expenses, - - -	1,150
Total, - -	54,500
If from this sum be deducted the expenses for boarding the passengers and servants, say about	14,000
There remain as the expenses for running the boat alone,	$ 40,500

As this steamboat peforms during nine months, daily, one hundred and fifty miles, or in the whole, forty thousand five hundred miles, the expenses for every mile the boat travels, amount to one dollar.

On the other side, the revenues of this boat are, at an average, for each trip, of one hundred and fifty miles:

From	62 cabin passengers, at $4, - -	$248
"	63 deck passengers, at $1, - - -	63
	125 passengers, at an average, per trip.	
For	25 tons of goods, at $3, - - -	75
"	transportation of U. S. mail, - -	4
	Total, -	$390

The amount of four dollars, received for transporting the mail one hundred and fifty miles, is, here, very small; the reason is, that the public prefer the mail boats to all others, on account of their safety and punctuality, in consequence of which, steamboat proprietors contract for the carrying of the mail even at the very lowest prices. The income of three hundred and ninety dollars per day, gives, for the nine months, one hundred and five thousand three hundred dollars, which, compared with the expense of fifty-four thousand five hundred dollars, shows an annual profit of fifty thousand eight hundred dollars. As the "Franklin" has only cost thirty thousand dollars, we see what an enormous profit those steamboats yield in America, which are frequented by a sufficient number of passengers.

The steamboat "Ambassador," the tonnage of which is twice as great as of the "Franklin," commenced her trips late in the Fall of 1837, and made, in that year, four voyages from Louisville to New Orleans, each of fourteen hundred and fifty miles, and four voyages back, together, therefore, running a distance of eleven thousand six hundred miles. The monthly expenses were eighty-five hundred dollars, which gives, for three months, twenty-five thousand five hundred dollars, or, per mile of travel, two dollars and twenty cents. In the year 1838, the "Ambassador" made ten trips from Louisville to New Orleans and back, and performed, therefore, twenty-nine thousand two hundred miles, within the period of eight months, the trips having been discontinued during four summer months, on account of low water. The total expenses for the whole year amounted to something over fifty-eight thousand dollars, which gives two dollars as the expense for running one mile. The salaries upon this boat amount, in consequence of her large size, and the long trips, to much more than upon the "Franklin," and are as follows, viz:

1 Captain receives, per year, - -	$2,000
1 first clerk, - - - -	1,200
1 second clerk, $50 per month, therefore in 8 months,	400
1 bar-keeper, $45 " " "	360

2 pilots, each $300 " " " both,	4,800
2 engineers, each $150 per month, out of which he has to pay his assistant; both in 8 months,	2,400
2 mates, one 75, and one $50 per month, therefore both in 8 months, - - -	1,000
1 ship carpenter, $60 per month, therefore in 8 months,	480
2 cooks, one 50, the other $30 " " both,	640
1 steward, $85, and 6 waiters, each $25, all in 7 and 8 months, - - - -	1,880
1 chambermaid, $25, and one washer woman, $20 per month, both in 8 months, - -	360
16 firemen, each $35, all in eight months,	4,480
8 common labourers, each $25 per month, all in 8 months, - - - - -	1,600
48 individuals receive, in total, - -	$21,600

As they have, at the same time, free board on the steamboat, it is evident that the expenses for the persons employed on the boats, are much larger here, than in any part of Europe. The above stated expense of two dollars per mile of travel, includes the cost for board of the passengers, but at the same time, no sum for general depreciation has been taken into account. These amounts will very nearly counterbalance each other, and therefore we may, on this boat, as well as on other first class steamers of four hundred to five hundred tons burden, take the expense, for every mile of travel, at two dollars.

The "Ambassador" carried, in 1838, at an average, one hundred cabin passengers, each of whom paid fifty dollars per passage up, and forty dollars per passage down the river, and one hundred to one hundred and fifty deck passengers, who paid, in part, five, and in part, eight dollars each; finally she carried, generally, two hundred tons of goods up, and three hundred tons down. The receipts, per trip, of fourteen hundred and fifty miles, were frequently seventy-five hundred dollars, while the expenses did not amount to more than twenty-nine hundred dollars, leaving, therefore, a very considerable net profit. On her trips, in 1839, the "Ambassador" averaged only, up to the month of June, sixty-five cabin passengers per trip, but nevertheless, the boat will again give a handsome profit.

The steamboats "Franklin" and "Ambassador" belong, as I observed, to the most elegant, and charge, therefore, highest; boats of a cheaper construction, and less elegant, with their crew not so well paid, incur much less expenses; and we find boats of two hundred and more tons, on which the expenses, per mile of travel, are only fifty cents. If, therefore, these boats only carry thirty-four passen-

gers at an average, each paying one and one half cent per mile, the expenses are already covered. Should the number of passengers be less, or the expense of running greater, the charges for transportation must be increased.

The steamboats between Wilmington, N. C. and Charleston, S. C., which run one hundred and sixty miles along the sea coast, performed, from the 1st of June, 1838, to the 1st of February, 1839, in the whole, two hundred and ninety-seven trips, and carried four thousand and seventy-one through passengers, and twelve hundred and twenty-five way passengers; the number of passengers, per trip, was, therefore, at an average, only eighteen, and still the company does a good business, because the passengers pay five cents per mile, and the steamboats carry goods, and the mail besides. It has been calculated, that a mile of travel, of these boats, after deducting the expenses for victuals, &c. for the passengers, and without taking into account the general depreciation, costs only fifty-four cents, and therefore eleven passengers will cover the daily current expenses.

The steamboat "Champion," of two hundred and forty tons burden, which makes regular trips between Pensacola and Mobile, performs daily, ninety-eight miles, and the current expenses, per day, amount to one hundred dollars, including the passengers' board; each passenger pays ten dollars for the passage, or ten cents per mile, and the average number of passengers, per day, is only ten; the receipts are, therefore, just sufficient to cover the current expenses.

7. *Comparison of the Cost of Transportation in Steamboats with that upon Rail Roads.*

If we compare the total yearly expenses on the American rail roads, with the number of miles traveled by all the trains during the same period, we find, as an average, that the expenses for every mile a rail road train travels, amount to one dollar; the same, as I have shown, is the cost of running a steamboat of two hundred or three hundred tons, one mile. It is surely a remarkable result, that the travel of a steamboat of two hundred feet in length, costs just as much as the running of a locomotive engine with a train of carriages, of nearly equal length; the speed of the rail roads, however, is somewhat greater than that of the steamboats, the former being twelve to fifteen miles, while the latter, upon the Ohio and Mississippi, will average only twelve miles. If the steamboats carry one hundred or more passengers, per trip, they can afford to take only two cents per passenger, per mile, while the average charge upon rail roads, is five cents; but if only few passengers are carried by steamboats, the price must be increased, and be, as we have seen, sometimes, even as high as

ten cents per mile. Upon the American rail roads, the average number of passengers in a train, is only forty, the charges, per mile, can, therefore, not be less than five cents, in order that the gross income, for every mile, performed by the train, may be two dollars, while one hundred passengers, at two cents per mile, upon steamboats, will give the same gross income (two dollars,) per mile of travel. Every thing depends, therefore, on the number of passengers; if this is great, steamboats and rail roads will pay well; if it is small, both must fail.

Steam navigation has, in every case, the advantage, that it allows or even invites competition and opposition; because hundreds of boats, belonging to as many different proprietors, may navigate the same river. Upon rail roads, on the contrary, the danger would be too great if the same course were allowed, and, therefore, the vehicles of only one company, which, in this manner, exercises a monopoly, are always running. It is owing to the competition of the American steamboats, that passengers are now carried at one-third of a cent per mile, and these low charges have alternately effected the enormous increase of the number of passengers; because passengers will now go round some hundred miles, to reach, for instance, the Mississippi, upon which to continue their journey. It is, in fact, incomprehensible, that on no rail road in America, the trial with low charges has been made; there are only some opposition lines, as between New York and Philadelphia, to be met with.

There is, however, a case where rail roads must be preferred to steamboats, let the number of passengers be large or small. This case will take effect in a few years, with two long rail road lines, now constructing in America. The one goes from New Orleans to Nashville; twenty miles of it have already been completed, over a swamp of unfathomable depth, upon which the whole track is floating, and by this construction alone is distinguished from other rail roads. The length of this road will be from New Orleans to Havanna, on the Tennessee, four hundred and thirty-four miles, while the distance to Havanna, by the Mississippi and Tennessee, amounts to more than three times as much. The other rail road, of one hundred and fifty-six miles in length, will extend from Pensacola to Montgomery, and be constructed in opposition to the steam navigation upon the Alabama river, between Mobile and Montgomery, which is three times greater in extent. In both cases it is certain that a road of one third the length will be preferred by the traveling public, even if the charges upon the steamboats should be one third or one fourth the price per mile.

8. *Steamboat Explosions and their Causes.*

In the official report from the Secretary of the Treasury, dated 13th of December, 1838, it is stated, that since the introduction of steam

navigation, up to the summer of 1838, or during twenty years, two hundred and sixty steamboats, with about two thousand passengers, have perished; this would give, per year, thirteen steamboats, (at an average) and one hundred passengers, which were lost. This loss cannot be regarded as so very considerable, considering that the United States now contain sixteen millions of inhabitants, and that certainly a far greater number of persons are killed upon roads; the explosions of steamboats, which are always described in every paper, with all their horrors, have nevertheless—not in America, but in Europe—greatly excited the public mind. Every traveler has it here in his power, to inform himself of the quality of the boat, and of her passages, before he takes his passage in the same, and with the large competition existing upon those rivers, he is always able to find boats upon whose safety he may rely. As a rule it may be taken, that the boats which have higher charges, are more safe than those which carry cheaper; and with a little precaution, and some more expense, therefore, we may trust ourselves in American steamboats, in which I have traveled myself already some thousands of miles, with the fullest confidence. It is, however, of interest, to know the causes of the disasters.

a. The greatest number of accidents happen upon the Mississippi and Ohio rivers, where the steamboats continue their passage day and night, from New Orleans to Pittsburgh; the length of this voyage is two thousand miles, and including the stoppages, necessary for taking in wood, and for landing and taking passengers on board, the trip is made in ten days up, and six or seven days down the river. In the first case, the engines are, through two hundred and forty hours, constantly at work, during which time the boilers are incessantly heated, though the same is still more the case with the engines in manufactories, and in the Atlantic steamships; it must be considered here, that Pittsburgh lies ten and one half degrees further to the north than New Orleans, and it requires a good health, to support the enormous difference in the temperature of the two cities; it becomes evident that the engineers superintending the engines cannot afford to give the same the required attention, and explosions must, consequently, become more numerous.

b. Many accidents happen by "snags" and "sawyers," so called. They are trees torn away from the banks of the river, which get fast with their roots at some point, and remain in positions most dangerous to the steamboats. Whole islands are sometimes formed by such floating trees. For removing these obstructions, particular machines have been invented, and are constantly employed upon these rivers.

c. The Americans are, as is known, the most enterprizing people in

the world, who justly say of themselves, "*we go always ahead.*" The democrats, here, never like to remain behind one another; on the contrary, each wants to get ahead of the rest. When two steamboats happen to get alongside each other, the passengers will encourage the Captains to run a race, which the latter agree to. The boilers, intended for a pressure of only one hundred pounds per square inch, are, by the accelerated generation of steam, exposed to a pressure of one hundred and fifty, and even two hundred pounds, and this goes sometimes so far, that the trial ends with an explosion. Seldom they have here, as they do in Europe, fixed in the boiler, a plate of a composition which melts at a certain degree of heat, and the fire becomes extinguished by the water. The races are the causes of most of the explosions, and yet they are still constantly taking place. The life of an American is indeed only a constant *racing*, and why should he fear it so much on board the steamboats?

d. In order not to lose too much time, wood is taken in only every twelve hours, the quantity they take, is, for large boats, thirty cords, or three thousand eight hundred and forty cubic feet. As generally hard wood is used, the additional load which the boat receives at once, and on its fore end, amounts to about eighteen hundred cwt., and in consequence thereof, the boat touches the bottom, sometimes, on the flat banks. The taking in of wood lasts one hour, during which, the fire is constantly kept up, and the steam attains a very high pressure, necessary, sometimes, to bring the boat afloat. At the same time, they often neglect to pump the necessary supply of water for the boilers, the iron in the flues becomes bare and red hot by the action of the flame, and when at the starting, the water again fills the boiler, the steam is so suddenly generated, that an explosion is the consequence. Although it is generally known that most explosions occur when the boats start, after having got their supply of wood, the thoughtless travellers remain, notwithstanding, on the fore part of the boat, where they are most exposed.

e. During the nights, it sometimes happens that in the windings of the river, two boats going at a great speed, meet each other, and by the concussion, the weaker boat instantly sinks.

f. I have observed already, that there are only two pilots upon each steamboat, which do their service alternately every four hours, but remain on board for the whole voyage, from New Orleans to Pittsburgh, of two thousand miles. It has never been the practice here to take new pilots from station to station, and the consequence is, that the pilots, not acquainted with such an extent of river, which, at the same time, is subject to so frequent changes, often run aground, and

that then the engineer, by using steam of too high a pressure, exposes the boat to explosions.

At a closer examination of all the causes of steamboat disasters, here we find that they all have their origin in neglect and imprudence. The rapid increase in the number of steamboats, has created such a demand for engineers and pilots, that the able individuals are by far not sufficient, and ignorant persons, not knowing the nature of the dangers, often manage the boats, and it is rather surprising that not more accidents occur. None of the causes which lead here to accidents, exist in Europe; in particular, would the known cautious temper of my German compatriots be sufficient to guard them from disasters of this kind. It is to be regretted, that steam navigation was carried on in America five years before it was successfully tried in Europe; it would be still more to be regretted, if at present, when in twenty years, with an expenditure of forty-five millions of dollars, the Americans have acquired such a mass of experience, and brought steam navigation to such a high degree of perfection, we were still to hesitate, in Europe, to adopt the American plan of construction. The steam navigation companies in Europe ought to compare the data given in this letter with the rate of wages and other prices in Europe, calculate, hereafter, the prices of transportation of passengers and goods, compare the same with their actual prices, and they will see the advantage which would result to them by the adoption of the American system.

[TO BE CONTINUED.]

Description of a new form of Edge Rail, to be called the Z rail, with its supports, fastenings, &c.—Making with it a part of a railway track of a new construction—With estimates of the strength and stiffness of the rail, &c.—and of the cost of the track—and a comparison of it in these particulars, with other forms of railway.

The track now described, will consist of the longitudinal under-sills, (a, a) 3×10 inches in the section, with cross ties (b, b) $3\frac{1}{2} \times 6$ and 7 feet long, placed upon them at intervals of three feet from centre to centre, and upon the cross ties notched one inch deep to receive them, will rest the string pieces (c, c) (of the trapezoidal section shewn) three inches wide at top, five and three-eighths at bottom, and five inches deep. A treenail one and a quarter inches diameter, is driven vertically through the three timbers at each cross tie, excepting the ties on which the string pieces join, where there are two treenails of one inch diameter. Both under-sill and string piece are twenty-one feet long, and break joints with the rail, (also twenty-one feet

long) and with each other. The section of the rail (d, d) resembles the letter Z, the head or upper table being turned to the one side of the stem, and the foot or lower table to the opposite side. The rail is placed against the inner side of the string piece, with the upper table lapping over the upper and inner edge of the string piece, and thus bearing on the *top* of the latter; and the lower table resting upon the cross ties, notched down three-eighths of an inch to receive it. A continuous top bearing on the string piece, and detached bottom bearings on the cross ties, are thus obtained. The rail is held against the upright inner side of the string piece by horizontal screw bolts (e, e) every three feet, which pass through the stem of the rail about midway between its top and bottom, and through the string piece; the head of the bolt bearing against the rail, and the nut, with a thin washer, against an open morticed seat in the outer slope of the string piece. These bolts (being nine to each bar of twenty-one feet) are placed at points midway between the cross ties, excepting the two in each bar at its end, which come over the cross ties on which the joints of the rail occur. The rail is further confined latterly at its foot, by the shoulder of the notch into which it descends, and also held down by a hook headed spike (f, f) driven vertically into each cross tie. At each joining of the rails, a cast iron joint plate (g, g) is let into the cross tie, to increase the bearing of the rails at these weaker points; this plate having on the outside a ledge to confine the feet of the rails, and two holes in it to permit the spikes lapping over them, to be driven downwards into the tie. The track thus constructed, will rest on a bed of broken stone, sand or gravel ballasting, ten feet wide at bottom, eight feet at top, and twelve inches deep, which will be filled up to the top of the cross tie, and one inch above the bottom of the string piece, and leave a depth of five and a half inches below the under sill for drainage, &c.

The rail is intended to weigh forty-five pounds per yard—its whole depth is five inches, thickness of stem nine-sixteenths of an inch—top bearing for the tread of the wheel one and a half inches, total breadth of upper table two and one-eighth inches—breadth of bearing of upper table on the string piece one and a half inches—breadth of foot inclusive of stem one and nine-sixteenths inches—the whole breadth of the upper and lower bearing surfaces three and one-sixteenth inches—bolt hole in the stem five-eighths of an inch diameter.

The proposed rail, and the structure of which it is a part, will admit, of course, of a variety of proportions. The forms and sizes of the several parts shewn in the preceding description and annexed drawing, are considered suitable and sufficient for a track intended for the heaviest tonnage and highest speeds. It is hardly necessary to say,

that the rail and its fastenings, in combination with the string piece and cross tie, form the only subjects of claim to invention; as the under-sill, ballasting, attachment by treenails, and even the trapezoidal form of the string piece (for economy of timber) are none of them new elements of the railway structure.*

The following is a brief enumeration of the particulars in which the undersigned considers his new rail an improvement upon the previous forms of the edge rail:

1st.—The lateral support given by the string piece to the rail, aided by the lateral strength given to the stem of the latter by the foot or lower web, permits the bar to be made thin and deep without the danger to which the stem of the T rail is subject, of buckling, or bending sidewise, under vertical pressure. Greater strength and stiffness is thus attained in the Z rail, with a given weight of metal, than in the plain T rail—and also than in the H rail, or Bridge rail; for in both of the latter sections, the width necessarily given to the base, for stability of position on its support, prevents the extension of the depth of the bar, sufficiently for the attainment of the strongest and stiffest form.

2d.—The mode of connection between the Z rail and its string piece, makes the latter supply the place of the heavy and expensive chair demanded by the T rail, while the Z rail still enjoys (and in a still greater degree than the T rail,) the superior strength and stiffness due to the *depth* of its section.

3d.—The same mode of connexion gives a continuous support to the upper table, which is not had by any other form of section. And this support not only extends the bearing surface on the wood, but immediately upholds, by an elastic cushion, that part of the head which, in the T and H rails, is so subject to crush, split off, and wear away under the wheels; a defect of these sections which will, it is believed, occasion ultimately their entire disuse.

* The rail as shown in the drawing, has a slope given to the under side of the upper table, in order to make it a little stronger in its connection with the stem. This makes a corresponding slope in the part of the top of the string piece, forming the seat of the rail. The inclination (though not at all essential to the plan,) is not enough to do any *harm;* as the *friction* of the wood and iron would suffice of itself to prevent *sliding*. The sloping seat of the rail may be easily and quickly prepared, and the corner of the string piece rounded, by a planing tool with a properly shaped cutter. It is well known to be necessary to dress (generally with an adze) the top of the string piece for the common plate rail, to amend imperfect sawing. The string piece of the Z rail will be readily sawed into its trapezoidal form at the mill. The open mortice forming the shoulder of the nut of the screw bolt, will be cut so as to *drain itself* of water falling into it. The treenail head may be caulked and pitched, to keep the water out, or driven obliquely so as to put its upper end under the top of the rail. In other details of construction, improvements may perhaps be made upon the plan now presented, retaining its general features.

4th.—The position of the rail on the *inside* of the string piece, makes the resistance of the rail to the outward lateral thrust of the flanges, as great as that of the string piece itself, a result which cannot be obtained so simply, effectually and economically, by any of the modes of fastening the rail on the *top* of the string piece, which must be employed with the H, or Bridge sections. The push of the flange against the rail, it is well known, is *the* force to be provided against, and this provision is made in the Z rail by the mere effect of its peculiar form; while other rails must be kept laterally in place by auxiliary attachments of iron, the bearing surfaces of which being individually small, must be multiplied expensively and injuriously to the wood, by wounding it at their points of insertion. The fastenings which attach the Z rail to the string piece, are subjected to little or no strain by the side action of the wheels, and are therefore left to the sole duty of maintaining the contact of the bar with its supporting beam, for the preservation of the joint action of the two in resistance to vertical pressure, and securing the correct *line* of the road.

5th.—The attachment of the rail to the string piece by a number of bolts passing through both, efficiently resist the tendency to endwise movement in the rail, the prevention of which has heretofore been so imperfectly guarded against. The contraction and expansion of the bar will be provided for, by the elastic yield of the wood at the bolt holes.

6th.—The *lining* of the inner edges of the rails at the joints, and the springing of the bars to, and their maintenance in, the curve of the road, will be effectually secured by the horizontal attachments of the rail and string piece. The importance and the difficulty of these adjustments must be acknowledged. The difficulty of making the tops of the bars fall in the same horizontal plane, is occasioned by the unavoidable differences in their *heights.* The simplest and best way of compensating these discrepancies is, probably, to raise by a detached elevation, the part of the cast chair or joint plate on which each of the uniting rails is to rest, and then the highest of the two bars can, by a proper tool, have its seat reduced by the amount of the excess in its height. This compensition will be required for the Z rail as for all edge rails. But the lateral adjustment of the rails to a line at the joints will, in the Z rail, be effected simply by the screwing of the stem against the string piece; for after this is done, the break, if any, which may show itself in the line of the inner edges, must be produced by a difference in the thickness of the slender stems of the two contiguous rails, which (unlike the variation in their heights) must be inappreciably small. In the broad base of the H rail as much room exists for discrepancies in the width as in the height of the bar, and

where the lateral alignment of the rails is effected through the lower web, it is very liable to imperfection. The T rail is less subject to this difficulty than the H rail, and the Bridge rail (in consequence of the facility afforded by the hollow in its base, and into which the chair may be made to go up) still less than either; but the Z rail (it is considered) is the least liable to it of all. And in regard to the bending the bars to, and retaining them in, the line of curvature, the advantage of the Z rail over the H, and Bridge rail, is obvious; both from the more moderate lateral stiffness of the Z rail, and the more direct action and extended resisting surface and adjustibility of its fastenings. The wide bases of the H and ∩ rails on which their strength and stability mainly depend, render them, it is well known, very difficult to deflect in curves, and next to impossible to prevent them from returning to the condition of *chords* from that of arcs, into which they had been temporarily forced in the construction of the track. The great increase of resistance and concussion in the passage of trains through curves situated in this way, need not be demonstrated.

7th.—The Z form of the section is the best adapted to bear the action of the wheels, the *coned* part of which, nearest the flange, imparting the most intense pressure, is received immediately by the *stem* of the rail, in which resides the main strength of every rail bar. In the T and H rails the stem is chiefly acted on through the inner ledge of the upper table, with a twisting action, unfavourable to the resistance of the bar; this part of the head suffering also much more severely from the wheel than the outer ledge. In the Bridge rail, the inner leg or half of the stem receives the principal action; the outer one being strained to a less extent—an inequality injurious to the strength and wear of the rail.

8th.—The simplicity of form of the Z rail section must make the rolling of it easier and cheaper than that of any other edge rail; while the disposition of the fibres and laminæ of the bar is as favourable as possible to strength and the endurance of wear.*

9th.—In efficiency, accessibility and capability of adjustment, the fastenings of the Z rail track possess, it is thought, strong points of superiority. The heavy strains and shocks to which railways are subject, and the consequent disposition of the numerous parts composing their structure, to give way and *work*, one with another, renders it very important that the attachments of those parts should be constantly open to inspection and very accessible. Fastenings capable of being readily tightened after working loose, such as key or screw bolts, are preferable therefore to spikes, or simple screws with-

* This opinion has been confirmed by that of a professional gentleman of great practical experience, in the manufacture of railway bars.

out nuts. But screw bolts used to fasten rails on the *top* of a timber support, must have either head or nut *under* the timber and buried in the ballasting, or filling of the track. In either case the bolt is much more difficult of inspection and adjustment, or removal, than the horizontal bolt of the Z rail.

10th.—The new proposed track is finally recommended by economy in the first cost and subsequent repairs, when contrasted with any known form of track of *equal strength of construction.*

In the "comparative table" below, there are three tracks, viz: the Philadelphia and Reading, the Washington Branch, and the Baltimore and Port Deposit, which are nearly identical with the Z rail track of 45 lbs. per yard, in estimated cost—while three others, viz: the Camden and Amboy, the Newcastle and Frenchtown, and the Wilmington and Susquehanna, fall short of it from $350 to $750 per mile. The comparison of strength, stiffness and general stability between these tracks and the Z rail track (45 lbs. per yard) which is contained in the columns of that table, from the 8th to the 16th inclusive, will, however, justify the claim of greater economy of construction and repairs in behalf of the latter. And if we go to the Z rail track of 35 lbs. per yard, we see an actual saving of $567 per mile in first cost, over the cheapest of the others, and with *all things considered*, a stronger structure; for the strength of the *track*, as a combination of parts, does not depend solely on the strength of the rail, but largely on the stability of the *connexions* of all the parts, in which particulars (as shown in the 14th and 15th columns) the lighter Z rail is seen to be much better provided than the tracks with which it is here compared.

TABLE, exhibiting the comparative weights, strength, stiffness, bearing surfaces, &c., of the Edge Rails used upon some of the principal Railways of the United States, with the relative quantities of timber, &c., employed in the superstructures connected with the several Rails, and the estimated cost of the Tracks per mile.

NAME OF RAIL ROAD, ON WHICH RAIL IS LAID.	Weight of rail per yd. linear.	No. of tons of rails pr. mile, pr. track	No. of lbs. of cast iron fastenings pr. mile.	No. of lbs. of wrought iron fastenings pr. mile.	No. of feet of timber, b'd measure, pr. mile in the track as constructed.	No. of ft. b'd measure pr. mile, with undersill 3x10 added to tracks without one.	Strength of the rail in tons, for a clear bearing of 30 inches.	Strength of the rail and string pieces combined, for same bearing.	Deflection of rail under the weight by which its *strength* is expressed.	Deflection of rail alone, under weight of 8 tons.	Deflect'n of rail & string piece comb'd, under weight of 8 tons.	Bearing surface, in square inches, resisting vertical pressure pr. running yard.	Surface resisting *lateral* pressure pr. lineal yard.	Surface resisting *longitudinal* pressure pr. yard.	Relative *virtual* bearing surfaces, having respect to relative *stiffness* of rails.	Estimated cost of a mile of single track on each plan, by the same scale of prices.
N. Jersey R. Road, T rail	38	59.71	52,800	2,728	63,360	—	4.21	—	.052	.099	—	45.	4.7	.40	25	$10,700
Boston & Worcester, T do.	38½	60.5	52,800	5,280	50,483	—	4.21	—	0.52	.099	—	34½	6.¼	.62	19	10,637
Balt. & Susq'anna, H. do.	58½	91.93	—	16,044	50,688	77,088	12.6	—	.050	.032	—	29.7	3.6	.56	51	11,556
Stoning'n & Provid'e, do.	58	91.14	7,040	4,752	82,720	—	12.6	—	.050	.032	—	22.5	3.75	.62	39	11,149
Long Island, do.	56½	89.	5,632	5,280	61,600	—	12.6	—	.050	.032	—	24.	3.	.62	41	10,587
Boston & Providence, do.	55	86.43	7,040	4,752	36,960	63,360	10.32	—	.054	.042	—	24.	3.	.62	31	10,352
Baltimore & O. R. R. do.	52	81.71	10,548	4,102	53,716	—	8.7	—	.055	.051	—	28.	4.	.62	31	10,354
Philad'a. & Reading, do.	45⅛	71.	5,910	5,005	55,174	81,574	8.11	—	.076	.075	—	26.9	4.	.62	20	9,451
Camden and Amboy, do.	45	70.71	6,600	2,237	60,555	—	7.65	—	.054	.056	—	19.	3.3	.62	19	9,114
N. Castle & F. Town, do.	43½	68.35	1,056	2,259	62,480	—	7.65	—	.054	.056	—	18.	3.5	.62	18	8,736
Washington Branch, do.	40	62.86	9,856	2,112	95,040	—	4.97	18.47	.076	.122	.033	117.	5.	.80	51	9,519
Balt. & P. Deposit, sq. rail,	40	62.86	—	2,959	118,800	—	2.72	23.66	.118	.347	.045	90.	1.12	1.12	14	9,428
Wil. & Susq'a, bridge rail,	40	62.86	11,668	2,816	57,200	—	4.58	—	.077	.135	—	$26\frac{4}{10}$	5.25	.50	11	8,752
Project'd bridge rail track	45	70.71	5,940	3,696	77,778	—	6.12	13.12	.069	.090	.044	130½	2.13	.65	80	9,927
Do. Z rail,	45	70.71	1,509	4,736	67,760	—	8.	10.41	.035	.035	.027	63⅜	9.12	1.60	100	9,482
Do. do.	35	55.02	1,509	3,269	67,760	—	5.72	9.85	.060	.084	.050	63	9.12	1.28	41	8,169

The stability of a railway track, like that of any other piece of framing or machinery, must be proportioned to the values of the resistances it presents to the several strains to which it is subjected. This being granted, as it must be, the undersigned feels himself warranted in appealing to the above tabular statement, as furnishing *demonstration* that the track which he has designed, is superior, in all the elements of stability, to any of its predecessors. In bearing surface to withstand *vertical* pressure, it is *twice* as well provided as the track which approaches nearest to it, and nine times better than the one which falls most short of it.

Its resistance to *lateral* movement, is 1½ times that of the track which comes the closest to it, and 8 times that of the one most behind it.

In the counteraction of *longitudinal* motion, it is better than the best of its competitors by nearly 50, and than the worst by 400 per cent.

Now, that improvement in these particulars in the present structures is wanted, the experience of every rail road company must have taught. The best and most expensively constructed railways of the country, cannot be closely inspected without its being perceived, that the connexions of their parts are too weak to withstand the action of their locomotive machinery. To a greater or less extent, in all those which have come under the examination of the undersigned, the wooden supports are crushed, the iron rails forced aside, and the joints either entirely closed or too widely opened. Spikes, bolts, and other fastenings, frequently give way, and where the maintenance of an accurate adjustment of the track is aimed at, much expense of material and labour, is incurred in replacing them; while the expedients resorted to, for restoring the deranged adjustments, cripple the timber, and convert the originally handsome structure into an unsightly piece of patch-work. There may be lines of railway, which have, in a measure, escaped these derangements; but has the trade and travel upon them been as yet very trying?

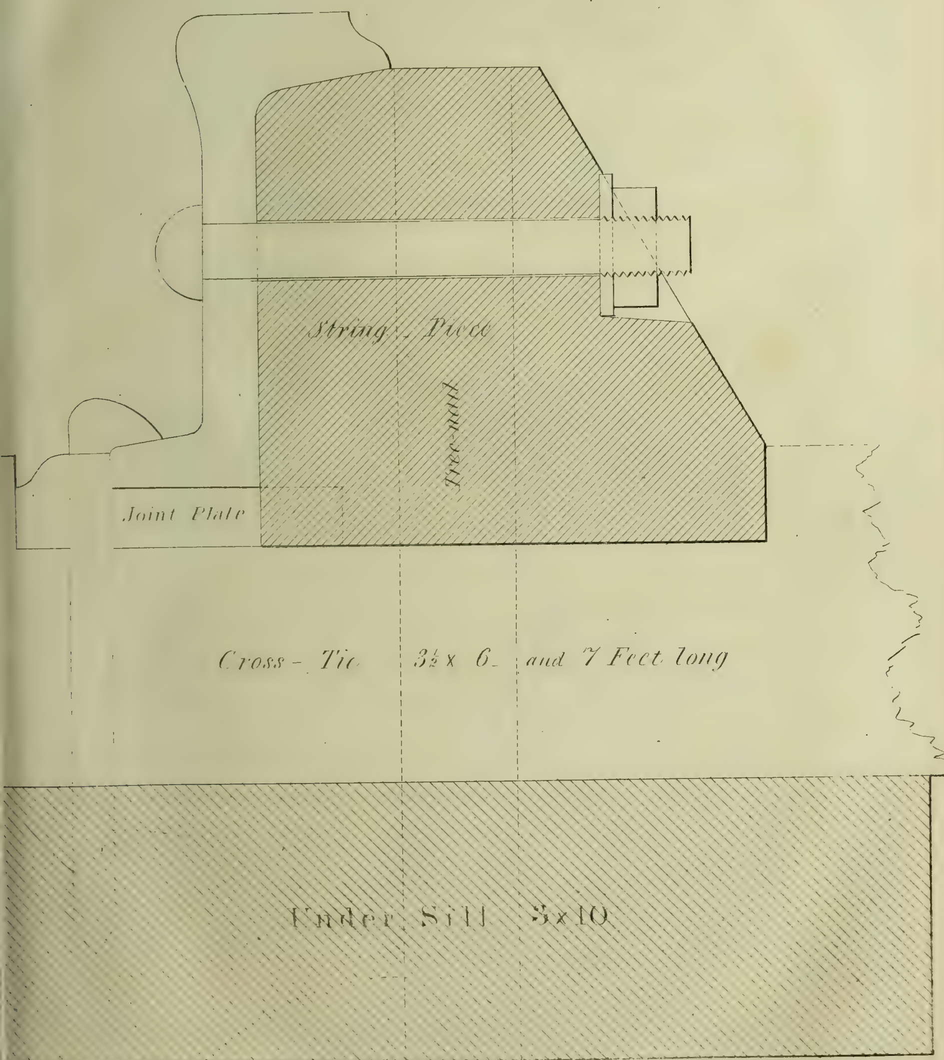
It may strike those who examine it, that the dependence of the Z rail, on the string piece, for *lateral* support and maintenance in its upright position, is objectionable. But when it is considered that on the string piece it is equally dependent for *vertical* support, like any other rail of continuous bearing on wood, the difficulty seems to disappear. The Z rail indeed *hangs* by its top on the inner edge of the string piece, just as the common plate rail rests thereon. The Z rail may, in fact, be regarded as an iron plating of the top and inside of the stringer; as long as the latter retains its stability, so long will the former—and we know that the stringer of the plate rail track would

Z. RAIL

HALF SIZE DRAWING

of the Cross Section of

Rail, String-Piece, Cross Tie, Under-Sill &c.



stand very well, if it did not crush under the weights from which its thin bar so poorly protects it. But it will be said, that the Z rail does not bear on the string pieces alone, but also on the cross tie. True, and if the latter bearing acted, or sustained the whole weight independently of the former, the string piece would then perform the office of a simple side support. This it would, indeed, be entirely competent to; but in fact it must of necessity bear the vertical pressure of the rail also, in consequence of the *intended* insufficiency of the tie, to sustain it unaided. The bearing area upon the tie is but nine square inches per running yard of rail, a surface experimentally known to be too small to resist compression in the *hardest woods we have.** Should then, the bearing of the rail, through defective fitting of the parts in construction, be thrown at first on the tie, it will soon become compressed under the travel, so as to bring the top bearing of the rail on the stringer into action; and where the latter bearing is perfect in the first instance, but afterwards withdrawn by *shrinkage of the timber*, the rail gradually indenting the tie as the stringer recedes, will follow the latter and maintain the constant harmony of the two bearings. This expected result depends upon such simple and obvious principles of mechanical action, that the undersigned cannot feel hesitation in his confidence of its occurrence. The amount of shrinkage in the string piece, will not exceed about one-eighth of an inch in extreme cases, and this much, the tie will assuredly compress. The cast iron plate at the joints, extends the tie bearings there, but not more than the rail requires from its greater weakness at those points.

There are, then, the best reasons to believe, that the rail and string piece will act together as a single beam, whose proportional height and width and connexion with its supports, will give it all the stability of position that can be desired. The string piece being fitted close and confined in the notch of the tie by a treenail, it is proposed to compensate for the small shrinkage of the former, by driving a thin wedge between it and the outer shoulder of the notch, so as to keep the gauge of the track from widening. Any other form of rail resting on top of a string piece, would equally indeed require this adjustment. The impression, then, that the dependence of the Z rail on its string piece is, in reality, greater than that of any other section of bar, supported by a continuous bearing, will, it is believed, be removed by reflection from the minds of those who may naturally receive it from a slight examination of the subject, and their ultimate conclusion, it is thought, will be, that the Z rail holds, on the other hand,

* The *locust* ties upon the new track of the Baltimore and Ohio Rail Road, when the bearing area is 28 inches per running yard, have all become more or less indented by the base of the rail.

the best possible position with respect to the timber with which it is connected, and that it will suffer no more from the decay of the wood than will any other rail, upheld in any other manner by a similar material.

BENJAMIN H. LATROBE, *Civil Engineer.*

Sketch of the Vicksburg and Jackson Rail Road, in Mississippi.

The Vicksburg and Jackson rail road extends from Vicksburg, on the Mississippi river, to Jackson, the capital of the State, on Pearl river, being, on the whole, a distance of 45 miles. It was commenced under the engineering supervision of H. S. Van Rensselaer, finished under that of Jeremiah Van Rensselaer, and opened to the public on the 1st of October, 1840.

Nature of the country.—Vicksburg, the western terminus, is situated on the side of that well known range of hills which make their appearance at Fulton, Randolph, and Memphis (the Chickasaw bluffs) in Tennessee, and at Vicksburg, Grand Gulf, Natchez, and Rodney, in Mississippi; they present, however, much less formidable impediments to internal improvement, in the former state, than in the latter, assuming, here, the appearance of small broken knobs, rarely uniting in ridges of any extent, and frequently intersected by ravines containing small streams of water, which, owing to the absence of materials for substantial culverts, have, on this road, rendered frequent recourse to trestle work, necessary. It may be proper here to state that, beside the termini, there are three principal depots, viz. Bolton's, Edward's, and Clinton, at the respective distances of 26, 18, and 34 miles from Vicksburg.

Soil.—The earth in the hills which extend from the Mississippi river to the Big Black, is of a yellow clay colour; it works easily with the pick, stands well, in excavation, at a slope of ½ to 1, and when trimmed with the shovel, will turn the rain, with scarcely any wash; when used on embankment, however, it becomes necessary to sow it with grass. From Big Black to Clinton, the ground is generally flat, and often marshy; the earth in the low ground being of an ashy colour, and making an excellent embankment; as you approach Clinton, the soil takes a sticky nature, melting in every rain, and hardening in the sun, so as to be almost intangible to the pick; in the excavations, great quantities of crystalized gypsum, and sometimes stone, are found, the latter is very soft and deliquesces when exposed to the air; the first mentioned properties of this earth render it very troublesome in *cuts*, it will hardly stand at a slope of 1½ to 1, and, in several places, piles have been driven (in one place, for half a mile,) to prevent its en-

croaches on the track; this kind of soil is found in all the excavations between Clinton and Jackson, which latter place is situated on the low ground of Pearl river, and but little above high water.

The following statement shows the relation between the straight lines and curves from Vicksburg to the depot, one mile from the eastern termination of the road, in the town of Jackson.

	Length in miles,	and chains.			
Straight line	" 31	" 76,			
Curves,	"	" 78,	having a radius of	7560	feet.
"	" 4	" 36,	" "	3780	"
"	" 1	" 46,	" "	2520	"
"	" 3	" 34,	" "	1890	"
"	"	" 54,	" "	1512	"
"	"	" 32,	" "	1260	"
"	"	" 34,	" "	1080	"
Total,	43	" 70.			

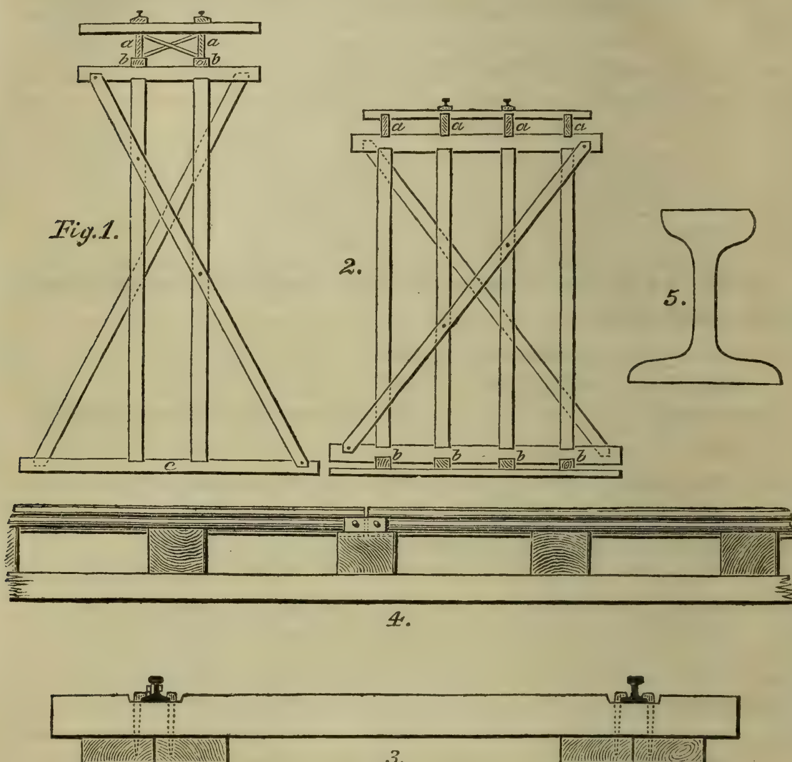
Below, is a view of the amount of the principal grades intermediate to the same points.

	Miles.	Chains.			
Level.	7	22.			
Ascending.	2	26,	at the rate of	55	feet per mile.
"	1	18,	"	53	" "
"	2	04,	"	48	" "
"	5	24,	"	40	" "
"		57,	"	36	" "
"		35,	"	35	" "
"	1	28,	"	32	" "
"		40,	"	28	" "
"		40,	"	25	" "
Descending.		48,	"	50	" "
"		33,	"	48	" "
"	3	54,	"	42	" "
"	3	29,	"	40	" "
"		22,	"	36	" "
"		53,	"	34	" "
"		40,	"	33	" "
"		67,	"	32	" "
"	1	32,	"	28	" "
"		17,	"	24	" "
"		47,	"	20	" "

Grading.—The excavations are made 18 feet wide at the bottom,

and sloped at the rate of six inches to the foot, embankments 14 feet wide at top, with a slope of $1\frac{1}{2}$ to 1.

Bridges.—There are seven sets of trestle work upon the road, of which that on the eastern bank of the Big Black river is the most extensive, it reaches half a mile, in spans of 22 ft., being, at its greatest elevation, 52 ft. in height; a section of it is shown in Fig. 1, *a* represents the corbel, or splice cap; *b*, the stringer, 22 feet long; the sill, *c*, is supported by piles, three under the foot of each post, and two under that of each brace.



Trestle work, No. 1, 3 miles from Vicksburg, is 165 feet long, and has an average height of 47.

Nos. 2, 3, and 4; 4, 9, and 11 miles from Vicksburg, are, respectively, 216, 410, and 478 feet in length. The King-post bridge, situated within a few yards of T. W., No. 2, extends 561 feet, in 17 consecutive spans of 33 feet each, supported by trestles, similar to those used at Big Black.

The bridge at the second crossing of Baker's Creek, 26 miles from Vicksburg, is a species of trestle work 100 feet long, in four 25 ft. spans.

The trestles are supported by piles driven into the bed of the creek; a section of it is represented in Fig. 2; *a*, the stringer, *b*, *b*, *b*, *b*, sills, acting as ties to the trestle, at the surface of the water.

The Big Black river is crossed at an elevation of 70 feet, by a bridge on Col. Long's plan, 416 feet long, the main span being 150 feet; this bridge is 17½ feet wide, has a treble set of posts, and quadruple set of stringers on each side, the posts are 20 feet long, and longitudinally of the bridge, 10 feet apart; immediately on leaving the bridge, you arrive at the trestle work, before mentioned.

At the first crossing of Baker's Creek, is a similar bridge, in one span of 80 feet.

Superstructure.—A side and end view of the superstructure are represented in Figs. 3 and 4. It consists of foundation sills, cross-ties, and iron, the sills, $3\frac{1}{2} \times 10$, are laid two and two on each side of the track, to break joints, the cross-ties, 5×7, are 7 feet long, and 2 feet apart from centre to centre. The sills and ties, for about half the length of the road, are cedar, the rest, cypress. The iron, a pattern of which is represented in Fig. 5, weighs 43 lbs. per yard, and is laid down in bars 18 feet in length, in such a way as to break joints; the spikes used, weigh three-fourths of a lb. each, and the plates under the ends of the rails, $2\frac{1}{6}$ lbs. each; 20 of the former are used to each bar.

There are 66 cars, (counting 4 wheels as a car,) at present used for transportation; they are, principally, 8 wheeled, and cost $800 each; 7 engines, 4 of which are of Baldwin's make, are in the possession of the company. The 5 employed during the last 3 months, have, in that time, travelled 26,014 miles, and cost, for repairs, $756, which includes the breakage of a crank.

The expenses for motive power, during the months of October, November, and December, including pay of engineer and fireman, fuel, oil, and repairs of engines, &c., amounted to -	$4,350 50
The maintenance of cars, for the same period,	758 50
The maintenance of way, - - -	9,278 34
Total expenses for the months of October, November, and December, were, - -	30,348 20
" receipts, - - - - -	55,015 35
Excess of receipts,	$24,667 15

I have taken the liberty to lay this communication before your readers, from the consideration that a brief account of the result of an enterprize upon which 2¼ millions of dollars, in northern capital, have been expended, might be productive of interest to them, and hope

that those possessing information relative to the more important ones at the North, will lay it before the public. G. C. W.

Extracts from the Second Report of the Directors of the New York and Erie Rail Road Company, to the Stockholders, February 3rd, 1841. *Signed, by order of the Board of Directors, by* Eleazar Lord, Esq., *President of the Company.**

Of the Route, Surveys, and Relations of the Road.

The route is in all respects most eligible for a work of such extent. Proceeding westwardly, from the harbour of New York, it traverses eleven counties within this State, its course being nearly midway between, and eighty to one hundred and twenty miles distant, from the Erie canal, and the canals which extend westward from Philadelphia. The physical character of the country precludes the construction of any rival work within fifty miles or more on either side; while the numerous streams and valleys which are intersected, afford great advantages of access to adjacent districts on the right and left.

The road will therefore, naturally, command the travel and tonnage of a very wide and extended region, comprising twenty-five or thirty thousand square miles, and a numerous population, besides a large proportion of the travel and traffic of the lakes and western states.

The line, moreover, has the advantage, on more than three quarters of the whole distance, of being laid in the valleys of rivers, and other considerable streams, as the Ramapo, the Delaware, the Susquehanna, the Chemung, the Canisteo, the Genessee, and the Alleghany rivers, and their tributaries, where the grades are extremely favourable, and the soil in the valleys west of the Delaware, adapted to the use of piles.

Excepting the portions previously located, surveys of the entire line of the road have been performed within the past year, including careful, and in some instances, very laborious examinations of different routes. It was the object of these surveys to improve the line as far as possible in respect to its length, grades, curvature, adaptation to the use of piles, economy of construction, and susceptibility of farther amendment with reference to an additional track; the directors having had it specially in view to establish the location where it ought to be, on the supposition of the road hereafter attaining all the importance as a thoroughfare of trade and travel, which the most sanguine have anticipated for it, and at the same time to secure the construction of a single track with the utmost practicable economy.

The original survey by Judge Wright, which possessed extraordinary merit, and entitled him to the enduring gratitude and respect of the company, exhibited a line four hundred and eighty-three miles in length; but at the same time indicated the most important points where farther examinations would probably result in shortening the distance, and in securing other advantages. Between his survey in 1834, and the close of 1838, re-surveys of the whole line and of dif-

* Extracted from the Report and Appendix. Communicated by Major T. S. Brown, C. E.

ferent routes on portions of it, costing, in the aggregate, more than $100,000, resulted in little more than a confirmation of the recommendations and suggestions contained in his report to the Legislature.

The surveys and examinations of the last year leave no room to doubt but that the line selected from Piermont to Deposit, one hundred and fifty-seven miles, and from Binghamton to Dunkirk, two hundred and fifty-one miles, is, taking every important consideration, present and prospective, into view, the best that can be obtained. Its length, allowing thirty-eight miles for the distance from Deposit to Binghamton, is four hundred and forty-six miles. It admits of a convenient and advantageous distribution into divisions, to be worked respectively by locomotives adapted in weight to the ruling grades of the several portions.

Next in importance to the route and location of the road, are its relations to other avenues and sources of travel and business.

Under this head it is obvious, first to notice its relation to the city of New York, the great mart for the products of this and the western states, and of the merchandize to be transported in return, for consumption in the interior; where, from the east and south, the great lines of travel meet, and where emigrants, and other passengers from Europe, for the most part make their landing in the country. When it is considered that the road extends, by the shortest practicable line, from this city to Lake Erie; that it is designed for the transport of heavy tonnage, as well as of passengers; that it will be open for use throughout the year; that the plan of its construction will render it competent to any conceivable amount of business, and that passengers may with safety be transported over it from one extremity to the other, in eighteen or twenty hours; the importance of its connexion with this metropolis, and the value of its local effects here in obviating the disadvantages of a northern climate, and rendering business as active, and supplies as cheap, in the winter as in the summer months, cannot fail to be apparent.

It has been supposed by some, that the termination of the road on the western shore of the Hudson, about twenty miles from this city, would prove disadvantageous, at least for some five or six weeks of the winter season; and in anticipation of such an objection, provision was made in the charter for extending the line to the city, from a point opposite to the Company's pier. Below that point, however, there is seldom, even temporarily, more obstruction from ice than on the ferries opposite to the city. The present winter, owing to the quantity of ice and the occurrence of severe storms, has occasioned difficulties as formidable as are likely to occur hereafter. Nevertheless, the company's boat has regularly performed her daily trips, and by her punctuality and success, has removed all doubt, and established full confidence, of the safety and advantage of this mode of communication with the road.

The pier, which extends about 4000 feet into the Hudson, forms a safe and valuable harbour, in connection with abundant space for all the accommodations of a depot.

Proceeding westwardly, the road passes through the valley of the

Ramapo, and a region of the most valuable iron ores, and divides the county of Orange into nearly equal parts. From Goshen, situate near the centre of the county, railways are proposed to Newburgh, distant about twenty miles; to the line of New Jersey, in a south-westerly direction; and to the north, through Kingston, Saugerties, and Catskill to Albany; of which the two former have been chartered. Near the western boundary of Orange, the line approaches the Delaware river, and intersects the Hudson and Delaware canal, which extends from the Hudson river, near Kingston, to the Anthracite coal beds of Pennsylvania.

In the county of Delaware, a rail road is proposed from Delhi, or from Walton, to Deposit.

In Broome county, the road intersects the Chenango canal, which extends from the Erie canal at Utica to the Susquehanna river; and also the line of a proposed railway from Utica to the Susquehanna, which has been chartered and surveyed; and another from Binghamton through Cortland and Onondaga counties, to Syracuse, and thence to Lake Ontario at Oswego, which has been chartered, and which, in connection with this road, will offer the most direct and eligible route from this city to Upper Canada.

At Oswego, in the county of Tioga, a connection occurs with the Ithaca and Oswego rail road, which extends from the Susquehanna to Cayuga lake, by the navigation of which, it forms an important route from the Erie canal. Near Tioga point, a connection is anticipated with the North Branch canal in Pennsylvania.

In the county of Chemung, the road intersects the Chemung canal at Elmira. The same point is contemplated as the termination of a rail road, which is in part constructed, from Williamsport in Pennsylvania, a distance of about seventy-five miles. To perfect a continuous line of railways from Philadelphia to Elmira, and thence, by a road of this Company, to lake Erie, is a principal object of this road.

It is supposed by some, (who, of course, are not aware how much the grades have been reduced, and the line shortened, on the eastern half of this road, since the original survey,) that on the completion of such a continuous line from Philadelphia to Elmira, the distance and amount of rise and fall between these two points will be less than between Elmira and the eastern termination of this road; and that both trade and travel will therefore be diverted from this route to Philadelphia. An examination of the subject has removed all apprehension of danger from this source. The distance from Elmira to the Hudson at Piermont, supposing the most eligible line from Binghamton to Deposit to be adopted, is two hundred and fifty-two miles, and the aggregate of ascents and descents, 3820 feet. The interval between Piermont and this city is entitled to be regarded only as a ferry.

From Williamsport to Philadelphia, several routes are projected and partly constructed; of which the most direct is that by way of Sunbury, Pottsville and Reading. Of this line, one hundred and fifty-one miles are nearly finished. Its length from Philadelphia to Elmira is two hundred and fifty-eight miles, and its rise and fall 5050 feet. It is moreover, encumbered with nine formidable inclined

planes, on which stationary power will be required, and is therefore not eligible for general trade or passengers. The next route in point of distance, is that via the Muncy Hills, Catawissa, and Reading, of which the length is two hundred and sixty-five miles, and the rise and fall 5530 feet; of this one hundred and fifty-two miles are completed, or far advanced. The third is a modification of the last mentioned route, and passes from Williamsport to Catawissa, by the valleys of the West and North Branch, instead of crossing the Muncy Hills. It is longer than those above referred to, but has less elevation to encounter, its length being two hundred and eighty-three miles, and its rise and fall 4630 feet; one hundred and fifty-two miles are nearly finished. The only remaining route passes down the Susquehanna to Harrisburg, and thence by way of Lancaster to Philadelphia, of which the length is two hundred and seventy-eight miles, the rise and fall 4790 feet, and the portion finished, one hundred and twenty-six miles.

Each of these different routes is in the hands of four or five distinct companies, and of course subject to the disadvantages incidental to separate interests and diverse modes of superstructure and management. The first is placed out of the pale of comparison by its inclined planes. The second is thirteen miles longer, has 1710 feet more of rise and fall, and cannot, from the arrangements of its grades and curves, be worked so economically. The third is longer by thirty-one miles, and has 810 feet more of rise and fall. The fourth has an excess in length of twenty-six miles, and in rise and fall of 970 feet.

Our road therefore, in view of this brief statement, to say nothing of its uniform character and management, or of the preference due to New York as a market, can be considered in no hazard of a diversion of its business by the lines in question, while as routes both of travel and transport from Philadelphia to lake Erie, and for the conveyance of coal and of iron from the district north of Williamsport, the Pennsylvania works will be largely tributary to the productiveness of the road of this Company.

At Corning, in the county of Steuben, the railway, forty miles in length, from Blossburg, in Pennsylvania, occupied chiefly in the transport of bituminous coal, terminates in the line of this road; which also, at the same place, intersects a navigable feeder of the Chemung canal. From Painted Post or Erwin, near the junction of the Canisteo with the Conhocton river, a rail road is proposed to be connected with this, extending up the valley of the Conhocton to the village of Bath, and thence to the Crooked lake.

In the county of Alleghany, at Cuba, the line of the road crosses the Genessee Valley canal, which extends from the Erie canal at Rochester, to the Alleghany river, a distance of one hundred and seven miles.

The line passing down the Olean creek, in the county of Cattaraugus, approaches the Alleghany river, along the northerly side of which it extends about thirty miles.

From the termination at Dunkirk, on the shore of lake Erie, a rail

road has been chartered and surveyed to Buffalo, forty-two miles; and another is proposed in the opposite direction, to be extended along the Southern shore of the lake, into the state of Ohio; from the Eastern border of which state, a continuous line of rail roads has been chartered, and portions of it constructed, through Ohio, Indiana, Michigan and Illinois, to the Mississippi, opposite to St. Louis, to be intersected in Illinois, by a route from the city of Cairo, at the junction of the Ohio and Mississippi.

The harbor of Dunkirk is spacious and secure. It is open earlier, and occasionally some weeks earlier, in the spring and later in the autumn than that of Buffalo.

This brief notice of the relations of this work to those natural and artificial avenues which intersect its route, and are already open, or are confidently anticipated, may serve in some degree to indicate its probable command of business, and its high claims to the confidence of its proprietors and of the public.

An examination of a map of this and the adjoining states, will show that most of the routes of travel and transport above noticed, are intersected nearly at right angles, which sufficiently characterizes them as tributaries instead of rivals. Their aggregate length is far greater than that of the main avenue. Those extending to the right will supply for distribution in the Southern, the salt, lime, gypsum, and various manufactures and products of the Northern counties of this State; while those approaching from the South and West, will furnish for transport from numerous points, anthracite and bituminous coal, iron, and the products of agriculture and of the forest.

Of the Cost of the Work.

The former estimates, as revised in 1835 and 1836, of the cost of constructing the work with a light superstructure and common plate rail, amounted to \$6,000,000. In these estimates, however, land-damages, depot buildings, water stations, and some other items, were omitted. Were the road, after being prepared under the contracts which have been made for grading and piling, to be finished with a superstructure like that formerly proposed, the cost would not exceed the amount above represented.

In the estimates above referred to, the cost of grading and preparing the road for the superstructure, amounted to \$ 3,900,075. Under the contracts which have been made, and to the extent of about one-third executed, and which cover the entire line, except the section between Binghamton and Deposit, about thirty-eight or forty miles, with an estimate supposed to be liberal for that section, the cost of grading, piling, bridging, masonry, &c., to prepare the road for the superstructure, will amount to \$3,840,000. The character of the work, however, which has been, and is to be, executed under these contracts, is deemed to be in some respects much superior to that contemplated in the original estimates, so as to adapt it with an edge rail, to the use of locomotives of double the weight formerly intended, and to the conveyance of proportionately heavier loads. The masonry is accordingly more solid and permanent; the bridges are

stronger, and in some instances, the grades are improved, and the line shortened, at considerable additional expense.

The adoption of piles in the construction of nearly two hundred miles of the road-way, is likewise deemed a great advantage over the ordinary method of grading. The piles used are generally of white oak, about twelve inches in diameter. They are driven by steam power, five feet apart from centre to centre, to such depth in all cases as to secure them from the effects of frost, and with such force as to leave them in no danger of settling under the pressure of any load. The tops of the piles being protected by timbers wide enough to cover them, it is supposed that they may endure about twelve or fifteen years. They form a road of uniformly even surface throughout the year, which is not liable to be obstructed by snow, and while they continue sound, will be subject to little or no expense for repairs. The difference between a piled and graded road for annual repairs will, it is believed, be sufficient in five or six years to defray the entire cost of renewing the piles; while the expense of working such a road, owing to the constant evenness and good condition of the rails, will be very considerably less than is commonly incurred on graded roads.

But though the preparation of the road-bed is not expected to cost more than was formerly contemplated, a very important change has been made in the plan and character of the superstructure, which will materially enhance its expense. The Directors being, after due investigation, satisfied that the ordinary plate rail and light timber formerly proposed, would be inadequate to the objects and business of this road, and in every point of view inexpedient, adopted an edge rail, of the most approved form, weighing fifty-six pounds per lineal yard, which, with the requisite chairs and spikes, will cost, delivered and distributed on the road, about $ 6,800 per mile of single track. This rail, instead of being supported only on cross ties, laid at intervals of three to five feet, as is the case on other roads, is to be laid on heavy longitudinal sills, connected by cross ties framed upon the upper surface, these sills, by giving to the iron a continuous bearing, contribute greatly to the strength and safety of the track.

The cost of this superstructure, including all materials excepting iron, with the labor of framing and laying it down, and laying the rails, will be about $ 1,900 per mile, making the entire cost of the rails, chairs, spikes, timbers and workmanship, $ 8,700 per mile.

Supposing the length of single track required in the first instance, with the necessary side tracks and turn outs, to be five hundred miles, the cost of iron alone, will, on the plan adopted, be $ 3,400,000; and of timber, workmanship, etc., $ 950,000, making $ 4,350,000, which is 74 per cent. more than was formerly allowed for the entire cost of the superstructure.

For the satisfaction of those who are not aware of the considerations which justify so enlarged an expenditure, it may be useful to refer to the experience of others on this subject.

The heaviest wrought iron rails in use in England, prior to the construction of the Liverpool and Manchester railway, were those on

the Stockton and Darlington road, which weighed but twenty-eight pounds to the yard; and proved to be much too light for general traffic, and unsafe for rapid travel. Rails, therefore, weighing thirty-five pounds to the yard, were adopted; but these also proving insufficient, were removed and others of sixty-four pounds were substituted, which still remain in use.

Profiting by the experience of the last mentioned Company, the Directors of the Liverpool and Manchester road adopted in the first instance a rail of thirty-five pounds, then the heaviest which had been used in England. A single year proved its insufficiency, and it was speedily followed by one of forty-four pounds, which again gave place to a different pattern, weighing fifty pounds per yard. A very few of the latter remain at present on the road, those now in use being chiefly of four different patterns, weighing respectively sixty, sixty-two, seventy, and seventy-five pounds per yard. Experience thus induced improvements in the construction, and an increase in the weight and cost of rails, until the vast strength of the forms of section now most approved, was attained.

The rails laid on the Midland Counties road, weighed per yard, - - - - - -	78 lbs.
Those laid on the Eastern Counties road, - -	76 lbs.
Those on the London and Birmingham, the London and Southampton, and London and Brighton Roads, - - -	75 lbs.
Those on the North Eastern Counties road, - -	69 lbs.
Those on the North Midland, and the Manchester and Birmingham roads, - - - - - -	65 lbs.
Those on the Great North of England road, - - -	62 lbs.
Those on the Great Western, now in progress, - -	56 lbs.

Of these, one only is as light as that adopted for this road; and in that instance, as in ours, the rail has a continuous bearing on a longitudinal sill; while all the others are supported on chairs, at intervals of three to five feet, weighing from twenty to over thirty lbs. each.

In this country, likewise, the results of experience abundantly show, that wherever it is an object to construct a railway, it is to the last degree desirable to obtain a heavy rail. On several roads where a light bar was originally laid, it has been replaced by one better adapted safely to permit rapid traveling, to sustain the severe shocks incident to a heavy trade, and to admit a constant and economical use; of such, the Columbia, New Castle and Frenchtown, Baltimore and Ohio, and others, might be referred to as instances.

The following statement of the cost of superstructure with heavy rails, on several roads, is extracted from a pamphlet published by B. H. Latrobe. The author does not give the actual cost in the several instances, but the calculated cost of the different plans of superstructure, at a tariff of prices, which he deems a fair average of this country:

Baltimore and Susquehanna, - - -	$11,556	per mile.
Stonington and Providence, - - -	11,149	"
New Jersey, - - - - -	10,700	"
Boston and Worcester, - - -	10,637	"

Long Island, - - - - -	$10,587	per mile.
Baltimore and Ohio, - - - -	10,354	"
Boston and Providence, - - -	10,352	"
Washington Branch, - - -	9,519	"
Philadelphia and Reading, - - -	9,451	"
Baltimore and Deposit, - - -	9,428	"
Camden and Amboy, - - - -	9,114	"
Wilmington and Susquehanna, - -	8,752	"
Newcastle and Frenchtown, - - -	8,736	"
Average of the above, - -	$10,026	"
New York and Erie, - - -	8,700	"

It was believed that with a plate rail, the road would be wholly inadequate to the travel and transport which it ought, and, if properly constructed, assuredly would command; that it would be unsafe for passengers, would be subject to enormous expense for repairs, and could not be economically used for the conveyance of tonnage; whereas, with a heavy rail, it would be competent to all its objects, could be worked with economy, would require but a moderate expense for repairs, and would be so much more productive and valuable, as to justify the confidence necessary to render it easier to accomplish its construction on the plan of an enlarged expenditure, than to carry out that originally proposed.

The cost of land and damages will be unusually small, probably not exceeding an average of $500 per mile; about three-fourths of the whole line, and suitable sites for depots being released without charge, and further gratuitous cessions being anticipated. Other donations of land having been made of the value, probably, of $1,000,000, and certainly more than sufficient to cover the cost of land for the roadway, this item is not brought into view in the following estimate of the cost of the work, viz:

For preparing the roadway for the superstructure, which includes grading, piling, masonry, bridging, fencing and superintendence, - - - - -	$3,840,000
For iron rails and appendages delivered and distributed,	3,400,000
For timber and workmanship for superstructure, - -	950,000
For locomotives and cars sufficient for the first operations on the road, - - - - - - - -	400,000
For passenger and freight depots, machine shops, water stations, engine houses and other necessary buildings, -	200,000
For interest and contingencies, - - - -	210,000
	$9,000,000

In view of this estimate, which is so far founded on actual contracts, experience, and ascertained facts, as to be deemed worthy of confidence, it is apparent that further resources of capital than are yet at the disposal of the company, will be required. The Directors rely on the stock of the company, after large allowance for the disastrous consequences, to many of the original subscribers, of the conflagration in this city in December, 1835, and the commercial revulsion of the

ensuing years, for at least $3,000,000. The loan of the State heretofore granted, is of the like amount; and they trust that the progress, condition and promise of the undertaking, will be such, before the close of the present year, as to leave no doubt of the expediency, safety, and public utility, of such further aid from the State, as the speedy completion of the work shall require.

The contracts for grading and preparing the roadway, including the superstructure of wood, on about two hundred and forty miles, require the execution of those parts of the work within two years; the payments for which will be discharged by collections on the stock of the company, and the proceeds of State stock yet to be received under the existing law. The farther needful resources will be required for the purchase of iron. On the plan of preparing the roadway within two years, or thereabouts, it is highly desirable that the Company should be enabled to contract for the iron rails, of which 35,000 tons are yet wanted, and for locomotives and cars, in the course of the present year, on account of the length of time required for their manufacture, and delivery on the line of the road. The importance of the entire line being put in use, and rendered productive within the shortest possible period, after the road-bed is prepared, is apparent.

[TO BE CONTINUED.]

Architecture.

The Orders.

It is often asked by those who have never given much attention to the subject of architecture, why *new* orders are not invented, and architects are reproached for adhering to the proportions derived from the ancients. It will not, however, be difficult to show that such censures are unjust, as well as unreasonable.

The orders must either depend for their character on *proportion* or on *embellishment*. If their *proportions* are to be considered as constituting their distinctive qualities, we shall find the number inevitably reduced to three, without the possibility of ever increasing it; but if their *embellishments* are to be regarded as marks of distinction, we shall find *thousands* of orders, both ancient and modern; and almost every architect may claim the credit of having added to the stock.

The *proportions* of the orders are naturally resolved into the *robust* the *chaste*, and the *elegant*; in the Doric, we have the most massy effect that can be given to a column and entablature, consistent with the principles of beauty; in the Corinthian, we have all the lightness and delicacy that can be attained, without imparting an idea of weakness; while a medium between the two is found in the Ionic. In the Doric, therefore, we have *strength*, *robustness*, and *masculine* vigour; in the Corinthian, elegance, lightness, and feminine delicacy; and in the Ionic, a beautiful blending of these extremes into chasteness and

dignity. We may therefore attempt, with as much propriety, to add another letter to the alphabet, or another note to the musical scale, as to add to the number of these natural grades of proportion, called orders. Hence, instead of censuring modern architects for not inventing *new* orders, we must abuse the ancients for "using up" all the principles for proportioning them to be found in nature.

But if on the other hand, an order is to be recognised by its *embellishments*, then almost every building of antiquity may be said to be of a different order, as there are scarcely two to be found, in which the decorations of the columns and entablatures are precisely similar; if, for example, we refer to the monument of Lysicrates, and the tower of Andronicus Chyrrhestes, we shall find two antique specimens of the Corinthian order, presenting, in their embellishments, the extremes of poverty and richness, yet no one has ever thought of calling them separate orders. Many examples exist in our own country of columns and entablatures, which differ widely in their decorations from any thing the ancients ever did—Mr. Latrobe, for example, made an order in the entrance to the Supreme Court Room in the capitol at Washington, which is often denominated the *American order;* and if any modification of either of the three grand divisions of columnar architecture is entitled to the distinctive appellation of an order, that undoubtedly is; the shaft of the column is ornamented with the representation of twenty-four stalks of Indian corn, instead of the ordinary flutes and fillets; and the capital has the form of an inverted bell surrounded with eight ears of corn, a portion of the grains of each ear being gracefully displayed between the opening husks; the astragal between the shaft and the capital is made to represent a rope. But this order, novel and ingenious as it is, can only be considered as a modification of the Corinthian, having the same proportions, a bell-shaped capital, and foliated embellishments.

The same may be said of the two orders called Tuscan and Composite, which are usually added in Roman architecture to the three derived from Greece. The Tuscan is a mere coarse adaptation of the Doric, and the Composite, a blending of the Ionic and Corinthian in the proportions of the latter. Vitruvius, who wrote on architecture in the time of Augustus, speaks of these modifications, but nowhere calls them orders. There is, in fact, but *three* orders, the *Doric,* the *Ionic,* and the *Corinthian;* the *Tuscan* and the *Composite* not having the slightest claim to such an appellation.

In this view of the subject, we can never expect the invention of an entirely new order, nor is such an event desirable, even though it were practicable. Columnar architecture having reached *perfection* in the hands of the ancients, any attempt to improve the orders, or

to add to their number, would be nothing short of an attempt to improve perfection.

> "To guard a title that was rich before,
> To gild refined gold, to paint the lily,
> To throw a perfume on the violet,
> To smooth the ice, or add another hue
> Unto the rainbow, or with taper light
> To seek the beauteous eye of heaven to garnish,
> Is wasteful and ridiculous excess."

These observations are, of course, intended to apply exclusively to the art of building with columns. The architect may produce the most elegant compositions without having any reference whatever to the orders; but whenever he finds it necessary to introduce an entablature with insulated supports, he must turn to the principles developed by the ancients.

T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JANUARY, 1840.

With Remarks and Exemplifications by the Editor.

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1. For a *Horse Power;* Samuel S. Allen, Miamisburg, Montgomery County, Ohio, January 10.

In this horse power a vertical shaft is to be turned by means of a sweep, or lever, to which the horse is attached. This lever carries a wheel with teeth on the interior of its rim, which mash into two pinions, or wheels, and these into a pinion on the vertical shaft, an arrangement which is well known. The patentee observes that "it is a point of primary importance that there should be a perfectly equal bearing on the teeth, or leaves, of the pinions, an object which cannot be obtained by mere truth of workmanship." This equal bearing is obtained by allowing a small degree of lateral play to the upper gudgeon of the shaft, to compensate for want of truth, and unequal wear, in the pinions.

The claim is to "the manner of causing the teeth, or leaves, of the pinions to have, at all times, an equal bearing, by allowing play in one direction to the upper gudgeon of the main shaft, within its box, or bearing, as described." This is one of those small things which might suggest itself to any one, but which from its very simplicity is apt to be overlooked; when proposed, however, its utility is perfectly apparent, and is more worthy of a patent than many things requiring much more thought to mature them, but which, when matured, are of little practical utility.

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2. For *Disengaging Horses from Carriages;* Edwin Eastlack, Greenwich, Cumberland County, New Jersey, January 10.

The inventions for disengaging horses, when running away with a carriage, have been numerous, and several patents have been obtained for such inventions both here and in England, not one of which has been continued in use; their abandonment has not resulted from any inherent defectiveness in the means, there not having been any difficulty on this point, although they have, of course, differed in merit. There is a general indisposition to the use of such devices, as if they invited accident, and there is also some doubt whether, in a very large number of cases, it is not more safe to leave the horses attached to, than to disengage them from the carriage.

The arrangements made by the present patentee appear to be well devised, and they are elaborately described; the particular means adopted form the subject matter of the claims.

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3. For improved *Hurdles for Feeding Silk Worms;* Benjamin Benson, Smyrna, Kent County, Delaware, January 10.

"To my hurdle frame I append an endless revolving apron for the purpose of readily removing the filth from the worms; which endless apron I conduct in a manner which renders it much more convenient than the apron employed in the machine of Gamaliel Gay, upon which this is an improvement." "In the apparatus for which letters patent were obtained by Gamaliel Gay, a separate cloth or apron was appropriated to each hurdle, and the rollers upon which it was wound were placed on the sides of the frame, rendering it necessary to employ a much larger space between the respective frames than upon my plan, and greatly increasing its complexity, and the labour of using it." Mr. Benson passes an endless apron under a series of hurdles arranged in a line, and placed one above the other, and this apron is conducted by rollers which cross the hurdle frames, and are turned by means of a winch at one end of it.

Another improvement consists in the particular manner of constructing the hurdles, by which strips of paper are allowed to descend in a fringe-like manner from their lower sides, serving for the worms to mount upon, and also as a convenient lodgment for their cocoons.

The claims made are to "the mode of arranging an endless revolving apron passing lengthwise of a general frame containing several tiers of hurdles for feeding silk worms; it being constructed in such manner as that one apron shall serve to collect and convey the filth from all the hurdles, in the way set forth, likewise the particular manner described of constructing the frames for a lodgment of cocoons, said frames consisting of sides pieces, slats, or covering of cloth, and strips of paper, or other material, combined or united together substantially as set forth.

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4. For a *Steam Cooking Stove;* Peter Getz, City of Lancaster, Pennsylvania, January 11.

This stove is not well represented in the drawing, or clearly described in the specification. Its main feature is the placing of a boiler at its back end, which shall occupy the whole space between the side

plates, and extend from top to bottom, or nearly so, and the placing of a steam chest above the top plate, extending nearly over the whole top, and into which steam is to be admitted from the boiler. The boiler holes are in the upper part of this steam chest, and between its bottom and the top plate of the stove is a flue space. The draught from the fire is to pass through tubes in the lower part of this boiler, into a flue space of about an inch between it and the back plate of the stove. The claim is to "the combination of the tubular boiler with the steam chest, the whole being constructed and arranged substantially as set forth."

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5. For *Wheels for Railroad Cars;* William W. Bergstresser, Harrisburg, Dauphin County, Pennsylvania, January 11.

This car wheel is to have a plate extending from the hub to the rim, and it is to be strengthened by radiating brackets extending from one to the other, as in some other wheels that have been patented; the patentee says: "I would have it understood that I am aware that railroad car wheels have been cast in a single piece, with a concave disk uniting the hub and rim, and provided with brackets to sustain the hub and rim, but in these cases the brackets sustaining the hub are placed on the side of the disk opposite to those sustaining the rim, and I do not therefore claim this as my invention; but what I do claim, and desire to secure by letter patent, is the concave disk in combination with the arms, or spokes, curved in the direction of the concavity of the disk, as described, to prevent breakage in cooling."

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6. For *Evaporating Kettles;* Charles C. P. Crosby, City of Brooklyn, New York, January 11.

"The general nature of my invention or improvement is the use of iron or copper kettles having a square or parallelogram form at the top, or upper edge, with a round or oval bottom, also in setting two or more rows of kettles in an arch, or furnace, with no middle wall, or partition, of brick or stone; also in casting the kettles of less width than length, so that more kettles, each of the same contents, can be placed in an arch or furnace, between the fire furnace and the chimney, than can be of round kettles."

It is proposed to construct the furnace by merely building side and end walls, and it is stated that if kettles four feet long and three feet wide be employed, two such kettles placed end to end, would require the side walls to be seven feet eight inches apart, which will allow two inches bearing for the flanches; that if the arch be eighty feet long, it will contain fifty of these kettles between the fire place and the chimney. The kettles are to have rims, or flanches at top, which are to be rectangular, and are to be supported by the resting of these flanches on bars or gratings of iron, extending from wall to wall.

The particular purpose to which these kettles are to be applied is not mentioned, but it is stated that kettles so constructed and set will evaporate 8000 gallons of water by the use of four cords of wood. The claim is to "the mode of constructing the kettles as herein des-

cribed; viz: by making the bottom of the kettle round, or ovoid, and the top square, or a parallelogram, the sides at the edge being straight, with a flanch or rim on each side of sufficient thickness to give strength to, and support the kettle, say of about two inches; in combination with the mode of setting the kettles in an arch, or furnace, as herein set forth."

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7. For a machine for *Husking and Shelling Corn;* Samuel S. Allen, Miamisburg, Montgomery County, Ohio, January 15.

"My machine consists principally of a vertical conical nut, set with teeth, which is made to revolve within a case or curb, which case or curb is composed in part of movable slats or staves, which are so hinged, or hung, at their upper ends, as to allow their lower ends to move in and out, said lower ends being borne up towards the conical nut by straight, spiral, or other springs, said case or curb also consists in part of stationary pieces of wood, or metal, which are situated between the edges, or joinings of the movable slats or staves, in such manner as to allow said slats to play in and out without opening their joints, so as to admit a grain of corn, or other matter, to insinuate itself between said joints, and consequently to interfere with the action of the machine."

"I do not claim to be the first to have constructed a machine for shelling corn by the aid of a revolving conical nut, furnished with teeth, and placed within a curb; nor do I claim to be the first to have used spring staves to bear the corn up against the revolving nut, but what I do claim in the above machine is the manner in which I have arranged and combined the hinged staves, furnished with springs, with the stationary pieces, so as to allow the said staves to spring out without opening the joints between them."

We have seen this machine in actual operation, and can aver, therefore, that its action is perfect, and that it appears to be capable of performing as much work with the same power as any machine with which we are acquainted.

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8. For *Wheels for propelling Steam Vessels;* Matthew W. King, City of New York, January 15.

The claim under this patent will furnish a good general idea of the nature of the invention.

"What I claim as constituting my invention is the placing of a separate bucket on three or more consecutive rows of arms; the making of the centre arms longer than those towards the sides, so as to increase the diameter of the wheel toward the centre; and the giving to the end of each bucket a rounding form, by which it strikes upon the water more easily and quickly than when made square."

The buckets are to be so placed upon the arms as that their planes shall form an angle with the radii of the wheel, of from twenty to forty-five degrees, so that the revolution of the wheels shall cause the propelling faces of the buckets to leave the water in a position nearly vertical.

9. For *Cleaning Grain, Cooling, Conveying and Bolting Flour;* Aaron Bull, Caroline, Tompkins County, New York, January 16.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of cleaning, scowering and conveying grain, and cooling, bolting, and conveying flour, by a current of air produced by revolving fans, arranged in a horizontal, or inclined trunk, containing inclined planes for breaking the smut and sheltering the forward wheels from the current of air, and apertures for the escape of the smut, and apertures for the passsage of flour, grain, &c., as described."

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10. For making *Druggists' and other Boxes;* John H. Stevens, Assignee of C. E. Warner, City of New York, January 18.

This patent is taken for a lathe, or machine, for turning round boxes, of wood, such as are used for tooth powders, and various other purposes. This machine is described at great length, and the claims refer by letters to the particular devices as adopted by the patentee. It would be useless to attempt a general description of this machine, nor do we deem it a thing of importance, as we believe that it would be an easy task to perform all the operations with equal facility without interfering with the special arrangements described by the patentee.

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11. For an improved *Braiding Machine;* Dudley D. Sacket, Westfield, Hampden County, Massachusetts, January 22.

Those who know any thing of the braiding machine are aware of its unavoidable complexity. The machine as described in the specification of this patent is substantially the same with that heretofore in use; the improvements made, as pointed out in the claims, are "1st, In attaching the *form* to, and making it revolve with, the *carrier*, as described. 2nd, Attaching to the back of the *racer* a disk which plays into, and is carried by the carrier, as described. 3rd, In the employment of fly guides, for the purpose, and in the manner described."

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12. For making *Wrought Nails* for horse shoes, or other purposes; Theophilus Somerby, Wells, York County, Maine, January 22.

The general operation of this machine is the same with that of several others which have been essayed and abandoned; namely, the forming of nails from a rod, by means of dies formed on, or inserted in, rollers, to which a revolving or vibratory motion is given. This plan, therefore, could not be claimed, and that which is claimed, is contained within very narrow bounds, being to "the shear, or clipper, which separates the nail from the rod, in combination with the dies, and also the employment of the spiral spring inserted in the female die for throwing out the nail."

The defect in machines of this kind is in the formation of a feather, or burr, on the nails, along the closing edges of the dies; a difficulty which the apparatus described will not obviate.

13. For a *Tide and Current Wheel;* F. H. Southworth, City of St. Louis, Missouri, January 23.

"My tide or current wheel consists of a drum, or cylinder, revolving on an axis, which is generally placed vertically; said drum, or cylinder, being surrounded by buckets hinged thereto, so that they may open to receive the action of the water on one side thereof, whilst the buckets on the other side close, so as to pass round in the direction against that of the tide, or current, with little or no resistance. My principal improvement in the said wheel consists in the connecting together of the pairs of buckets which are diametrically opposite to each other, by means of rods jointed to said buckets, so that the opening or closing of one of them shall aid in effecting the reverse action in that with which it is connected." The claim is to the so connecting the buckets; and we have no doubt that the action of such a wheel will be much improved thereby; but in all cases where hinged buckets are to be opened and closed by the current of water, a large portion of the power is lost by the opening not taking place until the buckets have each passed to a considerable distance beyond the point at which it is generally supposed the force of the water will be communicated to them.

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14. For an improvement in the *Construction of Chimneys;* George H. Crossley, New Haven, Huron county, Ohio, January 28.

"The nature of this invention consists in constructing the jambs of the fire-place with two flues in each, said flues opening into a common funnel communicating with the main flue of the chimney, so that the apertures for admitting the air from the fire-places and rooms into the jambs, shall open into separate flues, instead of opening into a common flue; by means of which arrangement a draught will be created through the openings that will aid the draught of the chimney, while in the other case there being but one flue with only two apertures in it for admitting the air, the draught through one of these would have a tendency to obstruct the draught through the other." The foregoing is not a very clear announcement of the nature of the arrangement; nor can we make it clear without devoting more time and space to it than we are disposed to spare, as after a careful examination of the matter, we are not of opinion that the so-called improvement for curing smokey chimneys is likely to be productive of much benefit.

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15. For a *Grubbing Machine;* Young W. Short, Oglethorp county, Georgia, January 28.

This grubbing instrument consists of a piece of wood, or handle, about six feet long, and having another piece of wood about a foot long hinged to one end of it, in such manner as that when closed the handle and short piece will stand at about right-angles with each other. The parts which come together are faced with iron, or steel, grooved or furrowed like the jaws of pincers. The stuff to be grubbed is to be seized between these metallic plates, and the handle then consti-

tutes a lever, and the outer end of the short piece a fulcrum by which the grubbing is to be effected. The claim is to "the combination of the two pieces constructed and operating in the manner and for the purpose herein specified."

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16. For an improvement in *Grist Mills;* Elisha W. Welsh, Paris, Fauquier county, Virginia, January 20.

This improvement is in the manner of "keeping the bushes constantly against the spindles as they wear, and always lubricated;" and the claim is to "the self-adjusting mode of keeping the bush tight against the spindle by means of the wedges acting against the wedge-shaped sections of the bush, either by their own weight, or the addition of weights, as described." The arrangement which is the subject of this patent is so similar to others previously in use as not to merit a distinct description. We should say that there is not any substantial novelty in it, and we believe that any intelligent jury would confirm this opinion.

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17. For a *Plough;* Mahlon Smith, Tinicum, Bucks county, Pennsylvania, January 28.

The claims are to "the mode of securing the reversible cutter and share, by means of the vertical plate and its horizontal flanch, as set forth. To the mode of constructing and arranging the reversible rhomboidal cutter, so as to present four instead of two cutting edges, as described, and to the constructing the movable land-bar with a share, or wing attached, so that both may be advanced together." The numerous variations which are made the subjects of patents in ploughs, if described, would often present minute differences which do not appear to render the instrument either better or worse; and, at all events, an analysis of them would in most cases be equally difficult and profitless. Long continued use is the only test in most cases; and this is one which we cannot apply. In the case before us, we do not find any thing which calls for, or even admits of, special description.

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18. For *Removing Obstructions from Rail Road Tracks*; William and James Thorn, Plainfield, Essex county, New Jersey, January 29.

Two circular brushes are placed in front of the wheels of a locomotive, so that their bristles shall come into contact with the tops of the rails. The shafts upon which these brushes are placed stand horizontally, but making an angle, say of 45° with the rails, and they are driven by the contact of conical, or bevilled wheels, with the flanch of the front driving wheels. The patentees say, "We do not claim to be the inventors of revolving brushes for cleaning rail roads, but what we do claim to have invented is the before described mode of arranging the revolving brushes by placing them obliquely across the track; and in combination therewith the method of communicat-

ing the power to the brushes by means of the flanch on the front driving wheel acting on the conical wheel placed upon the axle of each of the revolving brushes, all as described."

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19. For a *Brick Machine;* Julius Willard, city of Baltimore, January 29.

The clay, placed within a box, is to be tempered by the revolution within the box of paddles placed upon a horizontal shaft. From this box the tempered clay is to be forced into a long sliding trough, the depth and width of a brick, and it is thus in part moulded, which moulding is completed by cutting the long strip of clay into proper lengths for a brick by means of wires stretched upon a frame, and so arranged as to answer that purpose. The claim is to "the manner of forming the clay into long strips by means of the moulding trough, constructed as described, and the combination of the same with the carriage and tempering apparatus."

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20. For an improvement in the *Shuttle;* James Baldwin, Nashua, Hillsbrough county, New Hampshire, January 31.

"The patentee says that his invention consists in furnishing the shuttle with such a spindle, spring, and catch, as will admit of the four conditions, or particulars, following, to wit: 1st. That the spring and catch be made of one piece, thereby avoiding the expense of separate catches and springs, and of fastening them separately to the body of the shuttle, as in all other shuttles now in use. 2nd. That the catch be fastened to the body of the shuttle by a screw, instead of playing upon a pin. 3rd. That by turning down the spindle with the bobbin upon it, into the mouth of the shuttle, it will be secured, and that it will be released by turning it up. 4th. That the head of the spindle be so formed, and the arrangements be such, that the spring shall press against that part of the head of the spindle which is back of the pin on which the spindle plays, instead of that part which is foward of said pin. The means and advantages of these arrangements are specially set forth and the following claim made.

"What I claim is the above described mode of furnishing the shuttle with a spring and catch in one piece, and so applying the spring to the spindle as that the rounded end of the head of the spindle shall come in contact with the spring, and by turning the spindle the catch is moved so as to release or receive the bobbin without any other operation."

Description of a Self-Acting Brake, for Rail Road Cars, for which letters patent of the United States were granted to George S. Griggs, *of Roxbury, in the county of Norfolk, Massachusetts, December* 31*st*, 1839.

We have been furnished by the patentee with the accompanying engravings of this apparatus, but as the view given of it, and the let-

ters of reference, do not correspond with those of the specification and drawings in the patent office, we give the following references to the engravings, and also the concluding part of the specification.

Fig. 1.

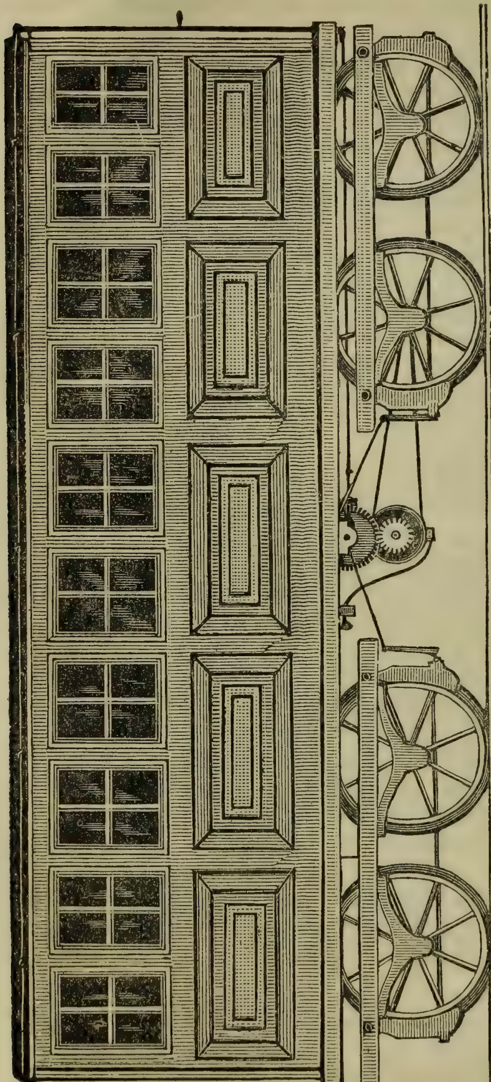

Fig. 2.

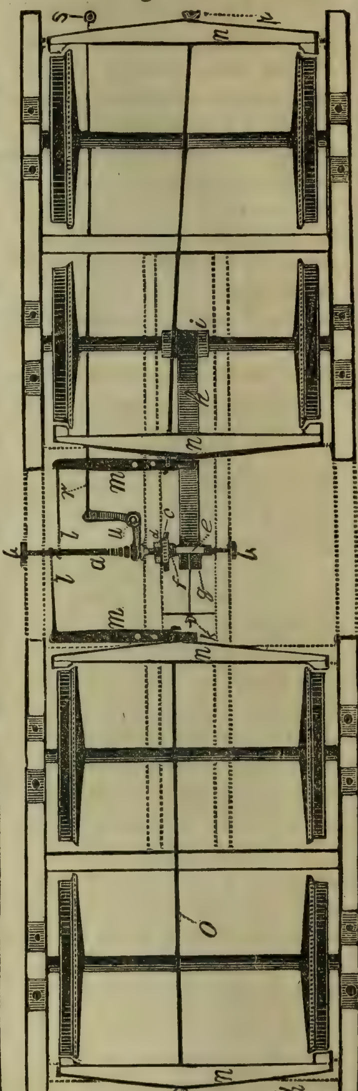

Fig. 1, is an elevation of an eight wheel car, with the *band and pulley brake,* attached. Fig. 2, an underside, or bottom, view of the brake.

a represents a shaft suspended to the body of the car by the boxes *b, b.*

c, a cog wheel which revolves on the shaft *a*, when not connected by the clutch *d*.

e, a frame suspended on the shaft *a*, supporting the pinion of the pulley *g*.

h, a belt passing over the pulley *g*, and the axle of the car *i*.

k, a tempering screw connected with the frame *e*, and with the body of the car, to keep the belt sufficiently tight just to allow the car wheels to turn, or to make them slide when the brakes are applied.

l, *l*, chains attached to the shaft *a*, and to the levers *m*, *m*, which wind round the shaft *a*, when the wheel *c*, is connected by the clutch on the shaft *a*.

m, *m*, levers connected to the brakes *n*, *n*, *n*, *n*, by the rods *o*, *o*, on one end of which are the tempering screws *p*, *p*, to adjust the brakes to the wheels, so that they shall cause them all to slide at the same time.

u, a forked lever supported by the frame of the car, to move the clutch *d*, by means of the rod *r*, which is connected with the upright lever *s*, the top of which is in the form of a T, to which is affixed lines leading to the engine, by which the wheel *c*, may be clutched to the shaft *a*, (the axle of the car acting on the pulley *g*, connected to the pinion *f*, by the belt *h*,) and cause the chains *l*, *l*, to wind on the shaft *a*, and thus to draw on the levers *m*, *m*, which being connected with the brakes *n*, *n*, *n*, *n*, cause them to stop the revolution of all the wheels.

"The advantages of this apparatus are, that the expense of brakemen may be saved, and the cars may be checked as soon as the engineer, or any other person forward sees danger; and the apparatus is much more effectual for this purpose than brakemen, and the danger arising from brakemen jumping off, as they sometimes do, is avoided, and the train is stopped much more suddenly than by the brakemen, without any shock, or strain; and in case of some cars of the train breaking loose, as they sometimes do, the lines may be so adjusted as that the lines for stopping the loose cars will, by the very circumstance of their breaking loose, be drawn until they are parted, and the loose cars thus stopped, instead of drifting along the railway, as they sometimes have done, to the great jeopardy of passengers.

"When the motion of the train is to be merely checked, but the train not stopped, the brakes of one or two cars, or more, that is to say as many as may be sufficient for the purpose, may be made to bear upon the wheels, the stopping of which, and their sliding on the rails, may be sufficient to check the speed as much as may be desired.

"I claim as my invention, and the subject of a patent, the causing of the revolution of the wheels to operate the brakes of railroad cars, in the manner, and by the mechanical contrivance substantially the same, and varying therefrom only in form; for the construction, as will be evident to every mechanic conversant with the subject, may be varied in its form very much without any invention, or the introduction of any new principle."

It appears from a number of testimonials of those who have used the foregoing brake, that it has fulfilled the intention of the patentee,

in a very satisfactory manner; we give, below, abstracts of four of these testimonials.

To Mr. G. S. Griggs,

For six months past, one of your band and pulley brakes has been in operation on a train of cars, of which I was engineer, on the Eastern Railroad, and I found it more effectual in stopping the progress of the train than any number of brakemen with the ordinary brakes. From the certainty of its operation I felt more confidence in being able to stop in case of difficulty, than with all others, with the complement of brakemen on a train. When moving at the rate of twenty-five miles an hour I could generally stop in the length of the train.

Yours, &c.,

Henry Thomas, Engineer.

Newburyport, July 22nd, 1840.

To Mr. G. S. Griggs,

Dear Sir,—Your patent band and pulley brake has been in use on our road for the last two months. I have seen and examined the operation of it daily, and in my opinion it is the best brake that has ever been applied to railroads. The safety of its operation is of the greatest importance to the traveling public, &c. &c.

S. Huestis, Boston and Providence R. R.

July 25th, 1840.

Under date of July 25th, 1840, Mr. Warren certifies that having used this brake upon the Boston and Worcester Railroad, at intervals, for the last year, he has found its operation very powerful, and that he believes that it has saved him from contact with cattle, and other obstructions on the track, on curves of the road, where they could not have been seen in time to have succeeded with the ordinary brake.

Mr. Geo. S. Griggs,

Dear Sir,—I have been employed for the last six years by the Boston and Providence R. R. Co., the last four of which I have had charge of a Locomotive Engine. During this period I have used many kinds of brakes, but have never found any so effectual as your patent brake, and I hope to hear of its being generally adopted by railroad corporations, as in my opinion it is not only the safest but the least expensive of any brake ever applied to railroad cars.

Yours, &c.

July 30th, 1840. Leonard Crossman.

Bibliographical Notice.

"*Remarks on the Mineralogy and Geology of Nova Scotia. By* Abraham Gesner, Esq., *Surgeon.*"

The above is the title of an octavo volume of about 250 pages, which was published at Halifax, N. S., some time since, but which

has but recently fallen under our notice. Were our pen less occupied, we would enter into a more formal review of this work than it is our intention now to do, and, probably, the present brief notice will be all that most of our readers would desire, more especially as we are compelled, after perusing it with care, to say that we find but little in it that can entitle the author to any praise as a writer, on descriptive mineralogy and geology. He has, certainly, shown some industry in collecting facts, but this has been done with little apparent disposition to inform his readers whence they were obtained, as a large portion of the book has, manifestly, been derived from a previous publication on the same subject, by two gentlemen of Boston, Dr. Jackson and Mr. Francis Alger, whose memoir he has not merely adopted as his model, but, to no small extent, has appropriated as his own.

Our present task will consist, principally, in furnishing some brief extracts from the work, and of short notices where extracts would occupy too much room, upon which extracts and notices the reader may make his own comments, and if these should not be of a character tending to exalt the reputation of the author for acumen and judgment, he alone must be responsible for the decision.

At page 11, we are told that the boulders of granite (rocking stones) were placed in their "present uneasy positions" by a volcanic eruption, instead of having been left there by the gradual decomposition of the rock beneath them.

Page 13. We are informed that the "sublimed sulphur" adhering to the sides of the transition rocks, in the vicinity of Halifax, shows that these rocks have been exposed to intense heat. Now we think it most probable that the substance here spoken of, is some saline efflorescence; if it is not, it will be difficult to convince geologists that its origin can be explained in this way.

Page 13 again. We learn that of which we were not before aware, that *sulphuret* of alumina and potash, form common alum.

Page 24. Here we find mention of primary clay slate, of which, we will risk our reputation, there never has been found a particle in Nova Scotia. The writer confounds it with the transition clay slate.

Page 29. "Sulphate of lime owes its origin to an affinity existing between lime and sulphur." This is a new discovery in chemical science.

Page 32. It is asserted that the ore of iron, at Clements, could not have been rendered magnetic by the igneous trap, because this rock is of a much later date. What of that? Has not the trap sent out immense dykes, which may be now seen running through the slate? and how could they have found their way there without carrying heat with them?

Page 34. Crystals of smoky quartz from Bridgetown, in the primary form. We have a desire to see some of them, as all we have hitherto seen from that place, are far removed from rhomboids.

Page 35. Here quartz crystals are cited as evidence of the igneous origin of granite. If we had no *better* proof of the igneous origin of granite, the nepturists might grapple with us with some effect.

Page 42. The theory given of the formation of blue vitriol is quite new to us. We did not know before, that "the air" could decompose sulphate of copper, so as to set free the sulphuric acid.

Page 46. We are informed that care should be taken to avoid the sulphuret of iron, as this salt hastens its destruction, and renders it unfit for roofing slate. Here is a salt hitherto unknown in chemistry.

Page 49. How does the author distinguish between old and new red sandstone, near Kentrilla, where he says "they are in contact?" We are satisfied that they belong to one and the same formation, though modified, perhaps, by local causes.

Page 52. Trilobites with two or more lobes. Query, how many lobes has a *trilobite?*

Page 65. It is said that in every instance the transition clay slate is above the granite. Surely such a natural and undisputed fact as this did not require this statement, and should not cause any wonderment.

Page 123. Here we find an attempt to illustrate a passage of scripture, which illustration, we doubt not, has appeared to many quite original, and which, in justice to the author's talent as a biblical interpreter, as shown upon several of his pages, we shall lay before our readers, entire. "Who can clearly decide that the flaming sword which forever shut out our first parents from Eden's delightful garden, was not a livid torrent of flame, issuing from the ground polluted by sin."

Page 126. It is said that there are no extensive formations of oolite in Nova Scotia. It would have been better to have said plainly that there were none at all.

Page 140. The copper ore at Carriboo River, is not found in veins, but beds, and the author should know the difference between them.

Page 147. One would suppose that phosphate of lime and arragonite, could readily be distinguished from each other.

Page 178. "We have not been able to discover that any of the crystals of specular iron ore possessed polarity." Here surprize is expressed at not finding what no body ever saw or heard of. Specular iron possessing polarity! it is scarcely magnetic.

Page 199. Here we have an occasional variety of analcime (the flesh coloured) confounded with the sarcolite of Thompson, (which

is the octahedral Keuphone spar) and described as occurring in the form of the primary *cube*, or gradually passing into the trapezohedron. Now we much doubt whether analcime, in a form *short* of the *perfect* trapesohedron has ever been found in Nova Scotia. It is probable that a very obtuse form of rhombohedral carbonate of lime had been mistaken for analcime.

Page 202. The mineral here described as Prehnite, has been shown to be a botryoidal variety of chalcedony. We have a piece of the very substance in our possession, which had been labeled Prehnite, by Dr. Gesner, and which we received from a source that may be relied upon. Of course, his description of the mineral was copied from the books, without examining it for himself.

Page 214. We should like to be informed when Sir Howard Douglass took the altitude of the precipice near Cape Split? We are inclined to think that the author has misquoted from a certain book, in which it was stated that Messrs. Jackson and Alger determined the height of this precipice, by means of Sir Howard Douglass's Semi-Reflecting Circle.

Page 217. We are told that the magnetic iron ore from Cape Blomidon, will yield "eighty-five per cent. of pure iron." If this be true, the author has discovered a new oxide of iron, containing more atoms of metal than those already known; for we had supposed that seventy-two per cent was the maximum of metal that the purest ore could contain. We advise him to make known his discovery forthwith; but we fear that he has not yet "had an opportunity to analyze it."

Page 219. The discovery of a mineral hitherto unknown in Nova Scotia, is here announced, viz.

Leocite. This mineral, however mortifying the truth may be to the author, proves to be nothing but trapesohedral analcime. If he had had the "opportunity to analyze it," he would have found its composition to conform to the formula for analcime, containing water and soda, instead of potash.

Page 219. We should suppose that leocite, and Messrs. Jackson and Alger's new mineral (Ledemite,) could not be easily confounded, as the latter occurs only in regular hexahedral prisms.

Page 248. Crystals of albin in the form of the octahedron. We have some misgivings on this point.

We have thus given the reader some idea of the character of this treatise on the mineralogy and geology of Nova Scotia, by a gentleman who has the reputation of being a man of science, and who has appeared before the public as a lecturer on chemistry, mineralogy, and geology. We think the references we have made, show, most

clearly, that at the time of writing the book, whatever may have been his attainments since, his knowledge of individual minerals was such that little dependence could be placed upon his descriptions, and that he betrayed his ignorance of some of the fixed principles of geology and chemistry. We could give other proofs of these assertions, should they be desirable; these are such as presented themselves in casually looking through the book. We will further observe, that a large number of the localities referred to, are not to be found in the map accompanying the work, and that the colouring of the map is by no means correct, though its principal and most accurate features have been copied (perhaps we ought to use a stronger word,) from the map prepared and published by Messrs. Jackson and Alger, who personally examined the same region several years before the publication by Dr. Gesner, and from whom, in other places, he has borrowed very liberally, with but a very summary and inadequate acknowledgment. Halifax itself, is represented as standing on primitive rock; and primitive, or granite, is the colouring given for nearly the whole formation of transition slate and quartz rock, when, in fact, the granite should be represented only in patches, here and there, as it happens to protrude itself through the slate.

Progress of Practical & Theoretical Mechanics & Chemistry.

Corrosion of Cast and Wrought Iron in Water. By Robert Mallet, A. I. C. E.

CONTINUED FROM PAGE 128.

The author next proceeds to the important question of the protection afforded by paints and varnishes. White lead perishes at once in foul water, both fresh and salt; caoutchouc dissolved in petroleum appears the most durable in hot water, and asphaltum varnish or boiled coal tar laid on while the iron is hot, under all circumstances. The zinc paint, which is now so much noticed as an article of commerce, the author has analysed, and states its composition as—

Sulphuret lead,	9.05
Oxide zinc,	4.15
Metallic zinc,	81.71
Sesqui oxide iron,	0.14
Silica,	1.81
Carbon,	1.20
Loss,	1.94
	100.

It may, *à priori*, be considered likely to produce a most excellent body for a sound and durable paint under water. The black oxide of manganese has no advantages but that of being a powerful drier. The defects of all oil paints arise from the instability of their bases;

the acids which enter into the constitution of all fixed oils readily quit their weakly positive organic bases to form salts with the oxides of the metel on which they may be laid. Hence we must look for improvements in our paints to those substances among the organic groups which have greater stability than the fat or fixed oils, and which, in the place of being acid, or haloid, are basic or neutral. The heavy oily matter obtained from the distillation of resin, called "resenien," and eupion, obtained from rapeseed oil, have valuable properties as the bases of paints.

Tables IX and X contain the results as to the corrosion of cast-iron in sea water when exposed in voltaic contact with various alloys of copper and zinc, copper and tin, or either of these metals separately, per square inch of surface. It appears that neither brass nor gun metal has any electro-chemical protective power over iron in water, but, on the contrary, promotes its corrosion. This question is only a particular case of the following general question—viz: if there be three metals, A, B, C, whereof A is electro-positive, and C electro-negative, with respect to B, and capable of forming various alloys, 2 a + C.... A + C....A + 2C; then if B be immersed in a solvent fluid in the presence of A, B will be electro-chemically preserved, and A corroded, and *vice versa.* If B be so immersed in the presence of C, B will be dissolved or corroded, and C electro-chemically preserved—the amount of loss sustained in either case being determined according to Faraday's "general law of volta-equivalents." The tables show that the loss sustained by cast iron in sea water, as compared with the loss sustained by an equal surface of the same cast iron in contact with copper, is 8.23 : 11.37; and when the cast iron was in contact with an alloy containing seven atoms of copper and one of zinc, the ratio was 8.23 : 13.21; so that the addition in this proportion of an electro-*positive* metal to the copper produces an alloy (a new metal, in fact) with higher electro-negative powers, in respect to cast iron, than copper itself. The author discusses many results equally remarkable, and is, therefore, enabled to suggest, by its chemical notation, the alloy of "no action," or that which in the presence of iron and a solvent would neither accelerate nor retard its solution, one of the components of this alloy being slightly electro-negative, and the other slightly electro-positive, with respect to cast iron. These results will also enable some advances to be made towards the solution of the important problem proposed by the author in his former report—viz: "the obtaining a mode of electro-chemical protection, such that while the metal (iron) shall be preserved, the protector shall not be acted on, and the protection of which shall be invariable."

Table X exhibits especially the results of the action of sea water on cast iron in the presence of copper and tin, or their alloys. It appears that copper and tin being both electro-negative with respect to cast iron, all their alloys increase or accelerate the rate of corrosion of cast iron in a solvent, though in very variable degrees; the maximum increase is produced by tin alone, thus indicating that this metal (contrary to what was previously believed) is more electro-negative to cast iron than copper. Hence the important practical deduction, that,

where submerged, works in iron must be in contact with either alloy—viz: brass or gun metal; common brass, or copper and zinc, is much to be preferred. These experiments will also serve to demonstrate the fallacy from many of the patented so-called preservatives of oxidation, which are brought before the public with so much parade.

The author, lastly, proceeds to the subject of the specific gravity of cast iron, tables of which are added to the preceding. The specific gravities here recorded were taken on equal sized cubes of the several cast irons cut by the planing machine, from bars of equal size, cast at the same temperature, in the same way, and cooled in equal times. Many of these results differ considerably from those given by Dr. Thompson and Mr. Fairbairn; which the author refers to the probability that those of Dr. Thompson were taken from pieces of the raw pig, and those of Mr. Fairbairn by weighing in air equal bulks cut from the mass by the chisel and file, by which latter process the volume is liable to condensation. The experiments of Mr. Fairbairn and Mr. Eaton Hodgkinson seem to show that the ultimate strength of cast iron is in the ratio of some function of the specific gravity dependent upon the following conditions—viz: 1. The bulk of the casting; 2. The depth or head of metal under which the casting was made; 3. The temperature at which the iron was poured into the mould; 4. The rate at which the casting was cooled.

Table XI. All the irons experimented on are arranged in classes, according to the character of the fracture; for which purpose the terms—1. Silvery, 2. Micaceous, 3. Mottled, 4. Bright grey, 5. Dull grey, and 6. Dark grey, have been adopted by the author as a sufficient basis on which to rest a uniform system of nomenclature for the physical characters of all cast irons, as recognisable by their fracture; and it is to be wished that experimenters in future would adopt this or some other uniform system of description, in place of the vague and often incorrect characteristics commonly attached to the appearance of the fracture of cast iron.

The twelfth and last table contains the results of a set of experiments on the important subject of the increase of density conferred on cast iron, by being cast under a considerable head of metal, the amount of which condensation had not been previously reduced to numbers. It shows an increase of density in large castings, for every two feet in depth, from two to fourteen feet deep of metal.

A very rapid increase of density takes place at first, and below four feet in depth a nearly uniform increment of condensation.

The importance of these results is obvious; for, if the ultimate cohesion of castings is as some function of their specific gravity, the results of experiments in relation to strength, made on castings of different magnitudes, or cast under different heads, can only be made comparable by involving their various specific gravities in the calculation. Mining Jour. Nov. 1840.

Electric Telegraph.

This extraordinary machine is now being worked on the Great Western Railroad, between Drayton and Paddington; and, though no distinct idea of the apparatus can be imparted without plates and draughts of the dial, pipes, rods, &c., of which it is composed, yet the principle will excite unqualified admiration when our readers learn that intelligence is conveyed at the rate of 200,000 miles per second, or 8000 times quicker than light travels during the same period, by means of electrical currents passing through coils of copper wire, placed immediately behind some fine magnetic needles, made to operate upon a circular series of twenty letters, which indicate such terms, either separately or collectively, as they have been arranged to represent. This telegraph will act both day and night, in all states of the weather, and with a rapidity so superior to the common process, that one minute only is required for the communication of thirty signals.

Ibid., August, 1840.

On the Composition of Crystallized Phosphoric Acid. By M. Eugene Peligot. Acad. des Sciences, 4th May, 1840.

M. Peligot refers to the experiments of M. Graham upon the combinations of phosphoric acid with water, and quotes the passage in which he supposes the existence of three compounds of this acid, with one, two, and three atoms of water respectively. He then gives an account of some experiments which he has recently made upon some crystaline substances found in bottles of phosphoric acid, which had been preserved for some years. The analyses of these crystals prove them to be compounds of phosphoric acid, respectively with three and two atoms of water, (PhO^5, 2HO and PHO^5, 3HO.)

Annales de Chimie et de Physique, March, 1840.

Memoir on the Examination for Arsenic in Judicial Inquiries. By M. L. Figuier.

After remarking upon the inconveniences which attend the use of Maesh's apparatus and its modifications by Liebig, Berzelius, Chevalier, and Orfila, M. Figuier traces the plan by which he proposes to avoid these evils.

The suspected matters are first cut into pieces, and boiled for four or five hours in water, a slight alkaline re-action being maintained in the liquid.

When cold, the fatty matters which swim on the surface are separated, and the liquid filtered.

The filtered liquid is then slightly acidulated by hydrochloric acid, evaporated to dryness, and the residuum dried but not carbonized.

It is then redissolved in warm water, and filtered to separate the deposit caused by desiccation.

The brown liquid thus obtained is submitted to a current of washed chlorine gas, until it ceases to be rendered turbid by the gas. The precipitate is again separated by filtration, and the liquid boiled in a porcelain capsule to expel the chlorine. The liquid is then introduced into a modification of Marsh's apparatus.

This consists of a flask closed by a cork, which is traversed by two tubes, one of which terminates at its upper extremity in a funnel, and descends to near the bottom of the flask. The other is a bent tube of about one-fourth of an inch in diameter, and drawn out at its extremity. In the horizontal part are placed some pieces of fused chloride of calcium, and farther on some fragments of porcelain; to this latter part of the tube the heat is to be applied.

About fifty grammes of zinc are placed in the flask, and the cork being put in place, sulphuric acid diluted with seven times its weight of water is poured in by the funnel tube. Hydrogen is formed which drives out the air from the apparatus. When the disengagement of the gas has gone on sufficiently long to avoid the danger of an explosion, that portion of the tube which contains the porcelain is heated to redness, and then the decoction, prepared as above, is poured into the flask. If the mixture in the flask foams so much as to be likely to enter the tube, five or six grammes of alcohol poured in through the funnel will check it instantly.

If the liquid examined contain any traces of arsenical poison it will soon shew itself at a short distance from the point heated red hot, and in the part of the tube drawn out, as a small brilliant circle of metallic arsenic, which augments as the operation proceeds; when this ceases to increase, the operation, which should last one or two hours, is stopped. The tube is cooled and separated from the rest of the apparatus. The characters of the metal may then be tested without injury to its metallic appearances. Finally the tube is hermetically closed at both ends, by the lamp, and preserved to be produced in court.

Journal de Pharmacie, October, 1840.

A New Blue Ink prepared from Prussian Blue.

Saturate with care, pure Prussian blue, with one-sixth of oxalic acid, and a little water, so as to form a paste, which is free from clots. It is then diluted with rain water until the desired shade is obtained, which is told by trying it upon white paper.

The colour is extremely deep; if the liquor is but slightly diluted, the writing appears perfectly black, and gives, upon drying, a copper lustre. By dilution the most beautiful shades are produced, even to the brightest azure. A slight addition of gum thickens the ink and prevents it from soaking through thin paper. Of course this ink is not indestructible; caustic potassa, hydrochloric acid, and water remove it. Messrs. Stephen and Nash have taken out a patent for it in England.

Ibid.

On a New Alum. By Dr. Mohr.

For sometime past there has been introduced into the German market an alum said to contain, in a state of great concentration, the principles which are principally active in dyeing and printing. This quality, it is said, renders its employment more advantageous, and diminishes considerably the expense of transportation. This alum has not the least resemblance to the ordinary potash alum, for it presents no trace of crystallization, but is in flat quadrangular plates, about an inch thick; it is white, feebly transparent, and dissolves very easily in water; its taste is sweetish, bitter, and aluminous, but much less stong than that of ordinary alum. If pulverized sulphate of potassa is thrown into a concentrated solution of this alum, a crust of common alum forms directly. Mr. Mohr has found its composition to be,

Alumina, - -	13.91
Sulphuric acid, -	36.24
Potassa, - - -	1.50
Water, - -	49.60

We see by this composition that the alum in question is, properly speaking, but a pure sulphate of alumina with eighteen atoms of water of crystallization. A compound mentioned by Berzelius in his Traitè de Chimie, and which in 100 parts contains 48.53 water of crystallization. It is probably prepared from pipe-clay, calcined and pulverized, and sulphuric acid not entirely concentrated; the mixture is boiled to dryness in appropriate vessels, by a strong fire, whence its peculiar non-crystalline appearance. This new alum is altogether free from iron, and replaces the ordinary alum in all its uses; but it is for the preparation of the mordant, acetate of alumina, that it offers the most essential advantage. In fact, as it contains scarcely any sulphate of potassa, one fourth the quantity of acetate of lead is saved in its decomposition by that salt, since the ordinary alum contains three atoms of sulphate of alumina and one of sulphate of potassa.

Ibid.

Mechanics' Register.

Power of Steam.—The greatest load lifted by any engine now at work in this country was by one in the Consolidated Mines, which raised a load of 9000 lbs. every double stroke it made, and did this nine times a minute, amounting to 267,022 tons, lifted seven feet six inches in twenty-four hours; and this astonishing machine could be started, stopped, or regulated, by a little boy.

Mining Jour. July 1840.

Salt Mine in Switzerland.—A salt mine has been discovered at Rheinfelden, in the canton of Argau, which the Swiss papers expect will be sufficiently abundant to supply all Switzerland, and thus save to the Confederation the 500,000 francs annually drawn from it for the purchase of foreign salt.—*Galignani's Messenger.*

Ibid. Aug. 1840.

Capital of Great Britain.—The grand total capital represented by all property in Great Britain and Ireland is estimated at 3,629,000,000*l.* The value of all sorts of public property is 103,000,000*l.* The value of lands, ships, canals, rail-roads, mines, horses, cattle, timber, crops, &c., is estimated at 2,945,000,000*l.* The value of all sorts of furniture, apparel, plate, specie, money in chancery, savings' banks, &c., is estimated at 580,000,000*l.* The national debt is about 764,000,000*l.*

Ibid, 1840.

Spontaneous Gas Company.—The directors of this company are actively prosecuting their unprecedented project. Pipes are casting, and ere many weeks have passed away, the Newcastle and North Shields railway will, in all probability, be lighted from the great natural reservoir of gas at Wallsend.—*Northern Times.*

Ibid, September, 1840.

French Steam Engines.—There are in France 950 steam engines, 719 French, 144 foreign, and 87 of unknown origin. Of 863 engines of known origin, 334 are low pressure, and 429 high pressure.

Ibid, 1840.

Meteorological Observations for January, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	22	23	29.93	29.50	E.	Brisk.	.85	Cloudy—snow and hail.
	2	16	23	.40	.45	W.	Moderate.		Clear—clear.
	3	4	6	.70	.75	W.	Brisk.		Clear—clear.
	4	4	19	30.05	30.06	W.	Calm.		Clear—lightly cloudy.
	5	14	25	.30	.33	E.	Moderate.		Cloudy—cloudy.
	6	35	36	.15	.75	E.	do.	1 20	Rain—rain.
☉	7	51	55	29.90	29 80	S.	Brisk.	1.00	Cloudy—rain.
	8	39	48	.90	.90	W.	Moderate.		Clear—clear.
	9	32	42	.95	30.00	W.N.	do.		Clear—lightly cloudy.
	10	33	36	30.00	.00	E.N.E.	do.		Cloudy—drizzle.
	11	38	44	29 80	29.70	E.	do.		Rain—rain.
	12	37	45	.96	.96	W.	do.		Clear—clear.
	13	33	34	30.10	.90	E.	do.	.70	Snow—snow.
☽	14	32	32	.00	30 10	E.	do.		Cloudy—cloudy.
	15	30	33	.05	.05	E.	do.	.15	Fog—fog.
	16	30	37	.23	.23	W.	Brisk.		Drizzle—cloudy.
	17	33	44	29 75	29.65	S.W.W.	Calm.	.60	Rain—cloudy.
	18	17	16	30.10	.90	W.	Moderate.		Clear—lightly cloudy.
	19	8	15	.50	30.53	N.W.	do.		Clear—hazy.
	20	18	29	.50	.40	N.E.	do.	.45	Snow—snow.
	21	32	36	29.80	29.74	N.E.	do.	1.05	Sleet—drizzle rain in night.
⊗	22	33	33	.80	.81	W.	do.	.15	Cloudy—cloudy.
	23	26	32	.75	.76	W.	do.		Cloudy—partially cloudy.
	24	30	44	.83	.75	S E.E.	do.		Cloudy—lightly do.
	25	31	43	.70	.70	W.	do.		Clear—clear.
	26	26	46	30.10	30.15	W.	do.		Clear—do.
	27	36	42	29 86	2 50	S.W.W.	do.	.03	Cloudy—cloudy.
	28	33	46	30 15	30.10	W.	do.		Clear—cloudy.
	29	34	34	.10	29 90	E.	do.	.38	Rain—rain.
	30	32	40	29 90	95	W.	do.		Partially cloudy.
☾	31	28	41	30 00	.96	W.	do.		Partially cloudy—cloudy.
	Mean	27.97	34.97	29.98	29.94			6.56	

	Thermometer.		Barometer.	
Maximum height during the month,	55 00	on the 7th.	30.75	on the 6th.
Minimum " "	4 00	on the 3rd and 4th.	29.40	" 2nd.
Mean	31.47		29.96	

	Colla… olo… va…		S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Pl	29⅓	4⅔	.	1⅔	⅔	3⅔	⅓	.	5⅓	....	.	....	....	.	1183
2	M	29⅓	14⅔	.	.	1	4⅔	⅔	.	⅔	....	.	.....	....	.	1276
3	Bu															
4	Le		15⅔	.	2	.	4	.	.	4	....	.	.....	....	.	1200
5	N	29	1	⅔	10⅔	.	2	.	.	8	....	.	.....	....	.	1195
6	M	29	7⅓	1⅓	3⅓	.	3	.	1	.	57.55	.	.....	68.32	.	1194
7	Pi	29⅓														
8	W															
9	Su															
10	Lu		4	3⅓	7⅔	⅓	2⅓	.	2	1	....	.	.....	....	.	1206
11	Sc	29	6⅔	.	3	4	9⅓	.	.	.	....	.	......	....	.	1184
12	Be	29⅓	8	.	4⅓	.	3	.	.	.	....	.	......	....	.	1311
13	Ch	30	11⅔	⅓	⅓	.	3⅓	1	1⅓	⅔	65.07	.	.....	....	.	1209
14	De	29⅔	3	1	3	1	2	⅔	.	⅓	64.46	2	.....	71.98	2	1193
15	La	29														
16	Yo															
17	Le		8	.	5	.	7⅔	.	.	.	62.43	3	.....	....	.	1185
18	Da	29	1	⅓	5	.	3	⅓	2	.	....	.	.....	72.26	.	1186
19	No	29														
20	Co															
21	Br															
22	Ti															
23	Ly															
24	Un															
25	Mi		4	.	⅔	.	2	.	14⅓	5⅓	....	.	.....	....	.	1189
26	Ju	29														
27	Pe															
28	Cu		3	⅔	3⅓	⅔	⅔	⅔	7	.	....	.	.....	....	.	1213
29	Ad	29⅓														
30	Fr		.	.	18⅔	.	.	.	.	.	....	.	.....	....	.	1215
31	Hu	29	2⅓	⅓	4	.	4⅓	.	4⅔	10⅓	....	.	.....	....	.	1190
32	Ce	29														
33	Pot		7⅔	.	20⅔	.	.	.	⅓	1	....	.	.....	71.71	.	1211
34	M'	27														
35	Cle		2⅓	1⅔	11⅓	1	2⅓	.	5⅓	2⅔	....	.	.....	....	.	1197
36	Ca	27 1⅔	9	4⅔	1⅓	6	2⅓	.	.	⅓	....	.	.....	....	.	1191
37	Be	28	4⅔	3⅓	4⅔	⅔	1⅓	.	12⅔	1	....	.	.....	....	.	1210
38	So	27	2⅔	.	7	.	1⅔	.	11⅔	.	....	.	...	....	.	1201
39	Ind	28														
40	Jeff		4⅓	.	1⅓	⅓	1⅓	.	14⅔	6⅔	....	.	....	....	.	1208
41	W	28 ⅔	4⅔	.	.	.	12	.	.	1	....	.	.....	....	.	1202
42	Ve	28														
43	Arr															
44	We		16	.	4	.	3	.	1	.	....	.	.....	....	.	1270
45	Fay	28														
46	Gre		6⅓	.	7	.	2⅓	.	⅔	8	65.21	15	......	71.13	16	1197
47	W	29														
48	All															
49	Bea		3	.	19⅓	.	⅔	.	.	.	....	.	.....	....	.	1198
50	Bu	28														
51	Me	⅔	5	.	7	.	2⅓	.	1	3	....	.	.....	....	.	1199
52	Cra	28														
53	Eri															

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
AUGUST, 1840.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.
1 Philadelphia,	Philadelphia,	J. M. Hamilton,	74.47	78.85	70.96	86.00	66.00	74.76	3	60.00	64.17	3
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	71.63	80.67	66.30	88.00	47.00	72.87	.	51.00	59.32	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,	65.74	70.00	67.57	83.00	57.00	67.77	1	....	....	.
6 Monroe	Stroudsburg,	A. M. Stokes,	66.65	81.05	70.20	88.00	50.00	72.63	11⅓	....	....	.
7 Pike,	Milford,	Ralph Bull,	60.80	78.90	62.50	87.00	51.00	67.40	.	50.00	57.68	.
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,										
10 Luzerne.	Wilkesbarre,	W. F. Dennis,										
11 Schuylkill,	Port Carbon	John G. Hewes,	64.27	80.81	66.25	90.00	54.00	70.44	1	52.00	60.30	1
12 Berks.	Reading,	C. F. Egelmann,	69.10	73.06	68.35	84.00	60.00	71.84	.	...	...	.
13 Chester,	West Chester,	Wm. W. Jefferies,	72.46	80.38	76.92	87.25	65.00	76.59	.	59.50	69.40	.
14 Delaware,	Haverford,	Haverford School,	69.87	79.68	68.06	86.00	60.00	72.54	⅓	54.00	60.30	⅓
15 Lancaster,	Lancaster,	Conservatory of Arts,	69.15	81.57	70.61	89.00	59.50	73.78	⅔	55.00	65.99	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	71.65	79.90	75.94	86.00	64.00	75.83	.	60.00	68.35	.
19 Northumberland.	Northumberland,	Andrew C. Huston,	68.68	77.44	70.77	85.00	60.00	72.30	.	49.00	59.23	.
20 Columbia,	Danville,	C. H. Frick.										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Rinkead,	61.94	81.63	66.94	92.00	53.50	70.17	5⅓	....	....	.
27 Perry.												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,										
29 Adams,	Gettysburg,	Prof. M. Jacobs,	67.39	80.58	70.35	86.50	59.00	72.77	.	51.00	62.55	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Jacob Miller,	67.87	83.03	69.45	91.00	55.00	73.45	.	....	....	.
32 Centre,	Bellefonte,	John Harris,	63.83	78.97	66.96	86.50	52.50	69.92	7	....	....	.
33 Potter,												
34 M'Kean.	Smithport,	Richard Chadwick,	61.23	75.55	56.87	86.00	48.00	64.55	.	41.00	53.00	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	63.13	76.72	62.87	86.00	49.00	67.57	2⅔	44.00	56.45	2
37 Bedford,	Bedford,	Samuel Brown,	70.87	78.68	74.15	87.20	60.50	74.57	.	....	....	.
38 Somerset,	Somerset,	George Mowry,	63.65	73.52	63.64	82.00	52.00	66.94	.	46.00	58.34	.
39 Indiana,	Indiana,	Richard White,	72.94	77.74	66.00	85.00	58.00	72.23	.	39.00	49.87	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	C. S. Brown,	65.82	73.62	71.38	82.00	55.00	70.27	6⅔	55.00	65.25	7
42 Venango,	Franklin,	Wm. Connely,	59.97	82.81	68.26	94.00	48.00	70.35	.	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weithers,	68.87	83.58	69.34	94.00	54.00	73.93	.	....	....	.
46 Green,												
47 Washington,	Cannonsburg,	A. H. Campbell,	66.29	78.78	70.13	86.00	52.00	71.73	.	49.00	61.03	.
48 Alleghany,	Pittsburgh,											
49 Beaver,	Beaver,	Wm. Allison,										
50 Butler,	Butler,	Jacob Mechling,	66.26	77.48	71.32	86.00	52.00	71.69	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	J. Limber,	68.97	77.21	68.48	92.00	60.00	71.55	1⅔	52.00	66.62	2
53 Erie,	Erie,	Park & Reid,										

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia	30.11	30.09	30.08	30.45	29.79	30.09	2⅓	24⅔	3⅔	2⅔	....	....	....	..	...
3 Bucks	30.01	29.99	29.97	30.35	29.71	29.99	.	19⅓	8⅓	3⅓	9	....	....	2	5.549
5 Northampton	29.93	29.91	29.91	30.30	29.59	29.92	3⅓	.	.	.	....	....	....		.....
6 Monroe	29.58	29.60	29.55	29.90	29.25	29.58	9⅓	6	14⅓	10⅔	....	....	....		2.740
7 Pike	29.58	29.55	29.57	29.93	29.23	29.57	.	16⅔	14⅓	.	....	....	....	..	......
11 Schuylkill	29.35	29.34	29.36	29.98	29.04	29.35	1	12⅔	17⅓	1	8	....	....	..	5.540
12 Berks	29.88	29.87	29.86	30.20	29.50	29.87	.	18	13	.	....	....	....	..	3.377
13 Chester	30.64	30.64	30.64	30.84	30.40	30.64	.	.	.	.	....	....	....	..	......
14 Delaware	29.56	29.56	29.56	29.90	29.25	29.56	7	15	9	7	9	....	....	..	3.658
15 Lancaster	29.52	29.50	29.51	29.87	29.15	29.51	⅔	18	12⅔	⅓	8	....	....	..	3.010
18 Dauphin	29.75	29.73	29.71	30.05	29.42	29.73	.	20	11	.	9	....	....	7	3.522
19 Northumberland	29.49	29.47	29.47	29.84	29.15	29.47	.	9⅔	21⅓	⅓	9	....	....	5	6.012
26 Juniata	29.51	29.43	29.49	29.84	29.16	29.48	5⅔	10	14⅔	6⅓	....	....	....	..	......
29 Adams	29.43	29.40	29.41	29.73	29.13	29.42	.	20	11	.	11	....	....	1	2.901
31 Huntingdon	29.38	29.35	29.36	29.69	29.08	29.36	.	25	6	.	8	....	....	..	3.442
32 Centre	29.30	29.31	29.38	29.64	29.01	29.30	7⅓	10⅔	12⅔	7⅔	5	....	....	..	6.086
34 M'Kean	28.06	28.07	28.03	28.25	27.80	28.05	.	7⅔	23⅓	.	8	....	....	..	5.095
36 Cambria	27.96	27.93	27.94	28.22	27.70	27.94	2⅔	9⅔	16⅔	4⅔	5	....	....	2	2.962
37 Bedford	29.26	29.24	29.26	29.55	28.98	29.26	.	19	12	.	....	....	....	..	......
38 Somerset	28.00	28.00	28.00	28.29	27.75	28.00	.	12⅓	18⅔	.	3	...	....	6	3.407
39 Indiana	28.68	28.67	28.65	29.00	28.40	28.67	.	14⅓	16⅔	.	5	....	....	5	4.220
41 Warren	28.83	28.81	28.83	29.20	28.58	28.82	6⅔	15⅓	9	6⅔	....	....	...	..	......
42 Venango	29.10	29.11	29.04	29.90	28.60	29.08	1⅓	16⅓	13⅓	1⅓	10	....	....	..	5.560
45 Fayette	28.99	29.00	29.01	29.30	28.68	29.00	.	21⅔	6	⅓	....	....	....	..	......
47 Washington	29.10	29.07	29.09	29.36	29.87	29.09	.	5	8	18	9	....	....	..	3.065
50 Butler	28.84	28.84	28.84	29.10	28.60	28.84	.	.	.	.	9	...	....	2	6.590
52 Crawford	28.78	28.78	28.77	29.08	28.53	28.78	2	12⅓	16⅓	2⅓	9	....	....	2	7.801

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia	⅔	⅔	1⅓	.	2⅓	⅓	3⅔	1	3⅓	1⅓	4⅔	.	1⅔	⅔	3⅔	⅓	.	5⅓	....	.	.....	....	.	1183
3 Bucks	.	1	1⅔	⅔	⅔	.	2⅓	⅓	2⅓	⅓	14⅔	.	.	1	4⅔	⅔	.	⅔	....	.	.....	....	.	1276
5 Northampton	.	.	1⅓	.	1⅓	.	2⅔	.	.	.	15⅔	.	2	.	4	.	.	4	....	.	.....	....	.	1200
6 Monroe	.	.	•	.	.	.	2⅔	.	6	.	1	⅔	10⅔	.	2	.	.	8	....	.	.....	....	.	1195
7 Pike	1⅓	.	1⅓	.	2⅓	⅓	1⅔	1	5	1⅓	7⅓	1⅓	3⅓	.	3	.	1	.	57.55	.	.....	68.32	.	1194
11 Schuylkill	⅓	.	1	.	2⅔	⅓	4⅓	.	1⅓	.	4	3⅓	7⅔	⅓	2⅓	.	2	1	....	.	.....	....	.	1206
12 Berks	.	.	.	.	⅓	.	3⅓	.	4	⅓	6⅔	.	3	4	9⅓	.	.	.	....	.	.....	....	.	1184
13 Chester	1	.	2	.	2⅓	.	3⅔	.	6⅔	.	8	.	4⅓	.	3	.	.	.	....	.	.....	....	.	1311
14 Delaware	⅔	1⅔	1	.	⅓	⅓	1⅔	⅓	1⅓	4⅔	11⅔	⅓	⅓	.	3⅓	1	1⅓	⅔	65.07	.	.....	....	.	1209
15 Lancaster	2⅔	.	1	.	1⅓	1⅓	2⅓	2⅓	7	2	3	1	3	1	2	⅔	.	⅓	64.46	2	.....	71.98	2	1193
18 Dauphin	1⅓	.	.	.	.	.	5⅔	.	3⅓	.	8	.	5	.	7⅔	.	.	.	62.43	3	.....	....	.	1185
19 Northumberland	2⅔	•	3⅔	.	⅔	⅓	3	.	9	.	1	⅓	5	.	3	⅓	2	.	....	.	.....	72.26	.	1186
26 Juniata	⅓	.	1⅓	.	⅓	.	2⅓	.	.	.	4	.	⅔	.	2	.	14⅓	5⅓	....	.	.....	....	.	1189
29 Adams	2⅓	.	.	.	.	.	2⅓	⅓	7⅔	2⅓	3	⅔	3⅓	⅔	⅔	⅔	7	.	....	.	.....	....	.	1213
31 Huntingdon	.	.	.	.	12⅓	.	.	.	.	.	.	.	18⅔	.	.	.	.	.	....	.	.....	....	.	1215
32 Centre	2⅔	.	.	.	⅔	⅔	1½	⅓	1⅓	.	2⅓	⅓	4	.	4⅓	.	4⅔	10⅓	....	.	.....	....	•	1190
34 M'Kean	.	.	.	•	⅓	.	1	.	.	.	7⅔	.	20⅔	.	.	.	⅓	1	....	.	.....	71.71	.	1211
36 Cambria	.	.	.	.	.	.	2	.	2⅓	.	2⅓	1⅔	11⅓	1	2⅓	.	5⅓	2⅔	....	.	.....	...	.	1197
37 Bedford	.	.	.	.	.	.	1⅔	3⅔	⅓	1⅔	9	4⅔	1⅓	6	2⅓	.	.	⅓	....	.	.. ..	....	.	1191
38 Somerset	.	.	.	.	.	.	1⅔	1⅓	⅔	.	4⅔	3⅓	4⅔	⅔	1⅓	.	12⅔	1	....	.	.....	....	.	1210
39 Indiana	•	.	.	.	.	.	5⅓	.	2⅔	.	2⅔	.	7	.	1⅔	.	11⅔	.	....	.	...	....	.	1201
41 Warren	⅓	.	⅓	.	.	.	⅔	⅓	.	⅔	4⅓	.	1⅓	⅓	1⅓	.	14⅔	6⅔	....	.	.....	....	.	1208
42 Venango	.	.	.	.	.	.	13⅓	.	.	.	4⅔	.	.	.	12	.	.	1	....	.	.....	....	.	1202
45 Fayette	1	.	.	.	.	.	2⅔	.	3⅓	.	16	.	4	.	3	.	1	.	....	.	.....	....	.	1270
47 Washington	⅓	.	1⅔	.	2	.	2	.	⅔	.	6⅓	.	7	.	2⅓	.	⅔	8	65.21	15	.....	71.13	16	1197
50 Butler	.	.	.	.	6	.	⅔	.	1⅓	.	3	.	19⅓	.	⅔	.	.	.	....	.	.....	....	.	1198
52 Crawford	2	.	.	.	⅓	.	1⅓	⅓	8	⅔	5	.	7	.	2⅓	.	1	3	....	.	.....	....	.	1199

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

APRIL, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 154.]

No notice has been taken in the foregoing of the effect of the quantity of water delivered upon the velocity, the means having been deduced from all the apertures under a given head.

The velocity is, however, increased under a given head by an increase of quantity, a fact of the more importance because the velocity may be then increased without lessening the ratio of effect to power. The amount may be deduced from the following table.

TABLE ELEVENTH.

Showing the velocity of the wheel with different widths of aperture. Overshot No. I. Taken from tables first and third.

Width of aperture.	Velocities for maximum effects with heads of 2.75	2.25	1.25	1.25	0.75	Mean velocity.
Inches.	Feet.	Feet.	Feet.	Feet.	Feet.	Feet.
0.50	5.28		4.65			4.96
0.75		5.21	4.77			4.99
1.00	5.43	6.01	5.28			5.57
1.25	5.58	5.50	4.83	6.20	4.77	5.38
1.50				6.10	5.07	5.58

It is obvious that if in the above table the columns for each head were filled, the relation shown by the mean would be independent of the head. Although this is only partially true in the present case we are warranted by the general examination of the results for each head, and then by the average, in concluding that a slight increase of velocity results from increased quantity, the head remaining the same. If the mean could be implicity trusted it would prove a tendency towards a maximum, by its slow increase. The quantity being tripled, the increase of velocity is thirteen per cent., increasing from 1.00 to 1.13. This, as has been before shown, is with the buckets less than three-tenths full. If the quantity were much increased, other circumstances would become operative.

The fact just presented will be useful in practice where water is plenty, and it is desirable to have a particular velocity for the periphery of the wheel.

The conclusion from table tenth requires correction, but there is danger of error in departing from mean results. The following may serve to approximate toward the effect of varying the quantity upon the ratio of the velocity of the wheel to that of the impinging water. The mode of calculation is precisely the same as that for table tenth. The data are from table first.

TABLE TWELFTH.

Approximate corrections for the average results of table tenth.

Table A.	Head above gate.	Velocity of efflux. Aperture		Velocity of impact. Aperture		Velocity of wheel. Aperture		Mean ratio of veloc. wheel to veloc. impact. Aperture	
Number.	Feet.	0.50	1.25	0.50	1.25	0.50	1.25	0.50	1.25
5 & 14	2.75	7.91	7.52	10.34	10.10	5.28	5.58	.52	.55
18 & 31	2.25	7.18*	7.16	9.78	9.78	5.21	5.50	.53	.56
33 & 45	1.25	6.53	5.45	9.56	8.82	4.65	4.83	.48	.55
							Mean	.51	.55

* This number is for aperture .75, but no sensible error will result from its use here.

This table shews that with the lesser apertures the ratio of the velocity of the wheel to that of the water falls below the average ratio about four per cent., and with the larger rises as much above it. The ratio here is below that shown by table eleventh, viz., as 1.00 to 1.07, the apertures in this case being increased two and a half times, and in the former three times.

The second question under the general head 2, (p. 150) is in reference to the effect of the form of the gate through which water is delivered to the wheel upon the velocity of the wheel.

We have found, in discussing the effect of the different forms of gate used with this wheel, (see table eighth,) that, at a mean, the gate *b* discharged more water through a given opening than *c* or *a*, and *c* more than *a*. The proportions were as 85, 72, and 63, or as 1.35, 1.14, and 1.00.

From the conclusion drawn from tables eleventh and twelfth, it appears that as the quantities of water under a given head are increased, the velocity of the wheel increases, though not in the proportion of the quantities. It ought, therefore, to follow that the form of the gate should influence the velocity; a question easily determined by recurring to the first, second, and third tables, and their summary in table fourth.

As the quantity of water delivered in a given time is an important element in the experimental data, it may be well to show here how closely the results from the mean of all the experiments made with a given head and form of gate, agree with the calculations from the experiments giving the ratio, and which are alluded to above. For this purpose it will be sufficient to give an abstract of the detailed tables, by which the discharges under different heads, and with gates *a*, *b*, and *c*, are compared with the theoretical discharges.

This is done in the following table; of which the first column contains the head; the second, the number of experiments from which the mean ratio is deduced; the third, the ratios of the observed discharge for gate *a*, to that calculated upon the head and aperture; the other columns contain data similar to those given in the second and third, but for gates *b* and *c*.

TABLE THIRTEENTH.

Mean ratio of practical and theoretical discharges through gates a, b, and c.

Head above gate.	Gate *a*.		Gate *b*.		Gate *c*.	
	Number of experiments used for mean.	Mean ratio, practical to theoretical discharge.	Number of experiments used for mean.	Mean ratio, practical to theoretical discharge.	Number of experiments used for mean.	Mean ratio, practical to theoretieal discharge.
Feet.						
2.75	15	0.58	12	0.94	6	0.73
1.25	14	0.61	4	0.93	6	0.74
0.75			3	0.85	5	0.72
0.50	6	0.77	3	0.77	3	0.70
		Mean, 0.65		Mean, 0.87		Mean, 0.72

The striking accordance of these results with the former ones (viz: .63, .85, .72) is at once seen. In fact the detailed tables before referred to show a very satisfactory coincidence of ratio in the actual to the theoretical discharges, the circumstances being the same, thus proving that uniformity of aperture was insured, where it was attempted. We may confidently rely that a gate of the form *b*, will discharge thirty-four per cent. more water than *a*, and twenty per cent. more than *c*, under the same head and opening.

The velocities of the wheel obtained with these gates are in conformity with the conclusions already drawn. A comparison of the velocities under corresponding heads, from table fourth, shows for *a*, a velocity of 4.92 feet per second, for *c*, a velocity of 5.58 feet, and for *b*, a velocity of 5.84 feet, the proportion of the velocities being as 1.00 to 1.13 and 1.18.

It may be laid down, then, that *while the form of the gate does not influence the ratio of effect to power, it affects the velocity of the wheel.*

This variation may depend, in fact, upon the variation of quantity as already shown, but *must also depend upon the manner in which the water is delivered to the wheel by the gate*, as may be seen from the following table. In it a comparison is made between the variation in the velocity of the wheel produced by a variation of aperture, which of course changes the quantity, and the variation produced by the gates. As the head of water also changes the quantity but at the same time varies the velocity of the water, the results under different heads are presented separately in the first tabular view, and any effect from the heads is in a great degree eliminated in the second by the mode of taking the average.

TABLE FOURTEENTH.

Presenting the variation in the velocity of the wheel by a change of aperture, and by a change in the form of gate. Overshot No. I.

Effect of variation of aperture drawn from table twelfth.

Head.	Ratio under widths of aperture of 0.50	1.25
2.75	1.00	1.06
2.25	1.00	1.05
1.25	1.00	1.04

The same from table eleventh.

Width of aperture.	Ratio of vel. wheel.
0.50	1.00
0.75	1.01
1.00	1.12
1.25	1.08
1.50	1.12

Effect of change of gate in varying velocity.

Relative quantities discharged by the three gates.	Relative velocities of the wheel produced.
1.00	1.00
1.14	1.13
1.35	1.18

It is plain from this examination that while an opening will soon

be reached which will give the maximum velocity, and the change in this element becomes inconsiderable, the form of gate is of great importance in practice, in consequence of the mode in which the water is delivered by it to the wheel.

The third question to be examined under the general head 2, (page 150) is the proper velocity to be given to the periphery of an overshot wheel. It is one of the points of our subject which has been much discussed. Smeaton at first assigned three feet per second as the proper velocity for the periphery of the wheel, afterwards adopted eight and a half feet, and Oliver Evans deduced nine feet per second as the result of his experience. The experiments of the Committee show that within the limits where the diminished action of the weight of the water upon the wheel, by an increase in the head, begins to diminish the effect, there is a considerable latitude as to velocity.

In wheel No. I, as will be seen by recurring to table sixth, between the lowest head which would fill the aperture (.50 foot,) and the highest which the experiments admitted, and where the ratios began sensibly to diminish (2.75 feet,) there is a diminution in the ratio of effect, of but two per cent; and between .50 and 1.25 feet, the diminution is scarcely sensible. The range of velocities between these limits is shown by table tenth to be, for

Gate *a*,	4.44	4.88	5.43
Gate *c*,	4.60	6.15	5.35
Gate *b*,	4.65	5.22	7.59*
And at a mean	4.56	5.42	6.12

The velocity of the wheel having been before proved to be connected with the velocity of the water falling into the buckets, we now see that *without diminishing the ratio of effect to power more than two per cent. we may so arrange a high overshot wheel as to increase the velocity of its periphery from four and a half to six and an eighth, and probably even to seven and a half feet per second.* It is thus easily understood that the proper velocity in a given case could not be detected by experience, but required experiment for its determination.

3. *The quantity of work* done in a given time depends, when the ratio of effect to power is the same, upon the velocity of the wheel. The remarks, therefore, which have been made upon the latter subject will serve as guides to determinations concerning the former.

4. *On the relative value of elbow and centre buckets in an overshot wheel.*—As has been previously stated, experiments were made

* On examining the table whence this number is taken, there does not appear evidence to question its correctness.

with wheel No. I, furnished with both elbow and centre buckets. It has been heretofore shown, table ninth, that the elbow buckets were of a proper figure; we now propose to compare the results of the two kinds of buckets in reference to the ratio of effect to power, and also in reference to the velocity of the wheel.

The following table is taken from tables C and D (vol. viii, pp. 89 and 147,) the first containing the experiments with the elbow, and the second with the centre buckets, gate *c* being used in each case. The velocities are those corresponding to equal apertures.

TABLE FIFTEENTH.

Comparison of the ratios of effect to power with elbow and centre buckets. Overshot No. I.

Head.	Elbow buckets table C.	Centre buckets table D.	Elbow buckets table C.	Centre buckets table D.	Aperture.
Feet.	Ratio.	Ratio.	Velocity.	Velocity.	Inches.
2.75	.814	.628	5.35	6.86	1.00
1.25	.841	.640	6.20	5.66	1.25
0.75	.841	.666	5.07	5.66	1.50
0.50	.831	.655	4.60	4.65	1.50
Mean	.832	.647	5.31	5.71	
Ratio	1.00	0.78	1.00	1.08	

The ratio of effect to power with the centre buckets, is but .78 of that with the elbow buckets. No doubt owing to the water sooner leaving the former than the latter, notwithstanding the assistance of the breast.

The velocity of the wheel appears to be greater in the second case than in the first. This is in part due to the increased quantity of water received into these buckets, as shown in table ninth, but perhaps more to the irregularity observable by comparing the results in the second or third column of the last table with themselves. The first velocity in the column for elbow buckets, appears to be too small, and the third in that for the centre buckets to be too great.

5. *On the use of air vents.*—It is doubtful whether there can be need of air vents in a properly constructed elbow bucket. The openings made in the soling for this purpose have been described in a former part of this report. The results of experiments made with these vents open and closed are annexed.

TABLE SIXTEENTH.

Experiments with air vents open or closed. Overshot No. I.

Head.	Width of aperture.	Elbow buckets table C.	Centre buckets table D.	Air vents.	Relative effect for elbow buckets.	Relative effect for centre buckets.
Feet.	Inches.	Ratio.	Ratio.			
2.75	1.00	.814	.634	Closed.	1.00	1.00
"	"	.809	.582	Open.	0.99	0.92

It appears that the air vents being open or closed made scarcely a sensible difference in the elbow buckets, and produced a loss, from the escape of water, in the centre buckets.

6. *On the results of an overshot wheel allowance being made for the loss of power by the head of water above the wheel.*—The overshot wheel, in practice, losing something in its effect by the head of water above the wheel, it will be useful to ascertain the allowance to be made for different heads, and also whether having made a correction for this, the difference between the effect and power is not greater than may be due to the water in part leaving the bucket before it reaches the bottom of the wheel, and in part being carried beyond the centre by the motion of the wheel.

The first of these questions cannot be settled by reference merely to wheel No. I, the heads being small in proportion to the fall, but for the same reason the second problem may be examined advantageously, and its results applied to the experiments with the other overshot wheels.

In this view the effect of an overshot wheel as practically used, is to be considered as composed of the impulse of the water and of its weight, or of an undershot and overshot. The undershot co-efficient, or ratio of effect to power, has not yet been obtained but may be considered for the present purpose as .284. The head through which this acts is composed of two parts, the head above the gate, and the distance from the gate to the bottom of the bucket of the wheel. As the water receives through the latter an acceleration due to the whole distance, a virtual head* must be found for it before adding it to the former. The sum being multiplied by the overshot co-efficient gives a number proportional to the whole effect of impulse.

The distance from the bottom of the bucket to the bottom of the wheel multiplied by the true overshot co-efficient gives its proportion-

* This for the mean of gates *a*, *b*, and *c*, will be the distance from the aperture to the soling, divided by $(.73)^2$, or by .533; or multiplied by 1.876.

al effect. The sum should be equal to the observed ratio of effect to power, multiplied by the head and fall.

The following table is calculated upon this principle, the quantity sought being what may be called the theoretical overshot co-efficient.

TABLE SEVENTEENTH.

Ratio of effect to power in a theoretical overshot wheel.

Head and fall. Feet.	Overshot co-efficient from table 6th.	Head above gate. Feet.	Virtual head of impulse. Feet.	Undershot co-efficient used.	Product of head and fall by overshot co-efficient.	Product of virtual head of impulse by undershot co-efficient	Difference of two products.	Fall below bottom of bucket.	Quotient, or theor. overshot co-efficient.
23.00	.828	2.74	4.06	.284	19.04	1.153	17.88	19.4	.921
21.50	.842	1.25	2.56	"	18.10	0.727	17.37	"	.895
20.75	.845	0.50	1.81	"	17.74	0.514	17.23	"	.888
								Mean	.901

The effect thus appears at a mean to be nearly nine tenths of the gravity of the water. This result would be accounted for if the water leave the wheel at an average of two feet above the bottom.

If now we assume the average co-efficient .900 for the effect of the theoretical overshot we shall find the co-efficients for the different heads and falls as follows:

For	23.00 feet	.811
"	21.50 "	.848
"	21.00 "	.858

being in defect and excess of the actual ratios at the two extremes, between one and two per cent. The small variation of the head and fall, however, as has been before remarked, renders the coincidence of this result a test of comparatively little value.

[TO BE CONTINUED.]

On Indigo. Part II. By J. C. Booth.

CONTINUED FROM PAGE 164.

The chemical relations of Indigo-blue.—The blue substance contained in the indigo of commerce, being the only one of importance in colouring operations, its singular and unique action with many of the chemical agents, next demands our attention. According to the method of preparing the pure blue colour, described in the preceding part of the essay, it will be observed that a protosalt of iron was precipitated by lime, the protoxide becoming peroxide, while the blue colour of the indigo disappeared, as it united with the

lime. Here, then, according to the most commonly received theory, the indigo-blue has been deoxidized, and combines with the lime, after the nature of an acid. This important change first requires attention.

1. *Reduction of Indigo-blue.*—The deoxidation may be effected by any substances which have a strong affinity for oxygen, such as phosphorus, the sulphurets of potassium, calcium, antimony, and many sulpho-salts, particularly the sulf-arsenites, by protosalts of tin, iron and manganese, farther by filings of zinc, iron, tin, &c. Even organic materials, in the process of fermentation, have a similar action. The presence of a free alkali or alkaline earth is essential to the change, and seems to act by its presence or catalytic influence, as metallic zinc decomposes water by the presence of sulphuric acid, which unites with the newly formed oxide; for none of the above named substances will deoxidize indigo unless an alkaline base be present to combine with it when reduced. Thus in the process described in Part I, the reduced indigo combines with the lime forming a soluble compound, while the iron is peroxidized at the expense of the oxygen of the indigo-blue and precipitates. After the solution of the calcareous compound has become perfectly clear, it is drawn off by a syphon into another flask, so as to fill it even to overflowing, by which a small portion of the blue, which has reformed, may be carried off. A few drops of concentrated sulphuric or acetic acid previously deprived of air by boiling or in vacuo, are now added, and the flask closed by a well ground stopper, whereupon an abundant white and flocculent precipitate appears which slowly collects at the bottom of the vessel. This is reduced or deoxidized indigo. The clear liquor is drawn off, and the precipitate, placed on a filter, is washed with well boiled water, (during which operation it gradually becomes grayish green,) then dried between paper and in vacuo, or even in the air at a very moderate temperature, 75° Fahrenheit. The greenish shade it assumes appears to be an intermediate state of oxidation between the white and blue. Reduced indigo is white, somewhat crystalline; has neither taste nor smell, does not redden litmus paper, and is insoluble in water. It dissolves in alcohol and ether, with a yellowish colour, from which it separates as indigo-blue, either by exposure to air or boiling down. In a moistened state, it becomes deep purple in a few hours, in dry air, it changes to blue, only after several days. So strong is its attraction for oxygen, that it cannot be kept even in closely stoppered bottles. By heating the dry mass cautiously in the open air, when the temperature rises to a certain point, it suddenly becomes dark and purple coloured; a phenomenon resembling the sudden oxidation of a metal. By a higher heat it rises as a pur-

ple gas. It appears to have no affinity towards dilute acids, but dissolves instantly in concentrated sulphuric acid, with a deep purple colour. The nature of this solution is unknown; but may it not arise from a reduction of a portion of sulphuric to hyposulphuric acid, which combines with the newly formed indigo-blue? It combines forcibly with strong bases, being dissolved by carbonated and caustic alkalies, and by caustic baryta, strontia and lime, with a yellow colour.

The combinations of reduced indigo with the bases cannot be obtained pure in a dry state, for even under the air-pump they change so far as to conceal their characters. Lime forms two combinations; the one exactly saturated with the indigo is soluble in water, the other with an excess of lime, insoluble, and of a citron yellow colour. Magnesia likewise forms a compound somewhat less soluble. Other compounds may be obtained by introducing a crystalized salt into a saturated solution of reduced indigo. Salts of alumina, protoxides of iron and tin, and oxide of lead, precipitate white compounds, which become instantly blue in the air; oxide of cobalt and protoxide of manganese, form green, and oxide of silver, brown and black precipitates.

It appears, then, that reduced indigo, although presenting no acid character in itself, combines with bases after the manner of an acid, forming both soluble and insoluble compounds; that its attraction for oxygen is powerful, becoming converted thereby into indigo-blue, which is an unusually indifferent substance.

When indigo is obtained from plants, it does not exist in the juice of the plant as such, but is formed after its expression, and by contact of the air. It is therefore highly probable that it is contained in it as reduced indigo, but as the latter is insoluble in acids, and requires the presence of a base, while the infusion of indigo plants always reddens litmus, it remains to be determined, by future experiments and observations, in what state it exists in the juice of the plants.

2. *Soluble Indigo-blue.*—Sulphuric acid has a peculiar decomposing action on various organic substances, combining with a portion of the generated products, and although retaining its acid character, ceases to exhibit the properties of sulphuric acid; for the body combined with the acid cannot be separated from it by bases, but enters into the composition of its salts, which are very different from sulphates. Indigo-blue is one of these substances, and exhibits properties, the theoretic nature of which remains a mystery.

When Indigo-blue, purified from the brown, red, &c., as described in Part I, is treated with fuming sulphuric acid, it combines with it rapidly, evolving heat, and no sulphurous acid; even dry sulphuric

acid produces the same result. Dilute acid has no action, and the stronger the acid, the more colouring material is dissolved. Thus while six parts of the fuming acid are requisite for the solution, twelve parts of strong oil of vitriol are required, and then usually with the assistance of a temperature not higher than 212° Fahrenheit. Such a solution communicates a distinct blue colour to 500,000 times as much water. As the exact nature of the combinations is not understood, we shall follow the ordinary nomenclature, and call the two acid compounds resulting from the solution, ceruleo-sulphuric and ceruleo-hyposulphuric acids; a third compound also results, called indigo-purple, or phenicine, but as it is unimportant, the mention of it may be sufficient. The more fuming the acid, the more blue hyposulphuric is formed, and the less residue of indigo-purple, while strong oil of vitriol produces more of the blue sulphuric, and frequently leaves a large portion of purple.

These acids may be prepared by digesting the pure indigo-blue in a dry state, in twelve parts of very concentrated sulphuric acid, adding the powdered colour little by little to the acid, and suffering the mixture to stand twenty-four or forty-eight hours, according to the temperature, which should not be above 212°; it is then diluted with thirty to fifty times its bulk of water, and filtered. What remains on the filter is indigo-purple. Wool or flannel, thoroughly cleansed by soap, a very dilute solution of carbonate of soda (1 to 100) and water, is immersed and digested in the liquid at a moderate warmth, by which the blue acids are extracted, and colour the wool of a deep blue. When all the colour is thus taken up, the wool is thoroughly washed with water, pressed, and put into a very dilute solution of carbonate of ammonia, whereupon the acids leave the wool and combine with the ammonia. This solution is evaporated to dryness at 140°, and treated with alcohol of 0.833, which dissolves the ceruleo-hyposulphate of ammonia, and leaves the blue sulphate undissolved.

Ceruleo-sulphuric acid is obtained by dissolving the last named salt in water, and precipitating with acetate of lead, which throws down ceruleo-sulphate of lead. By stirring this salt with water, and passing sulphuretted hydrogen through it, sulphuret of lead is precipitated while the reduced blue remains in the yellowish liquid. It is deoxidized blue in combination with sulphuric acid, which, by exposure to the air, becomes the ceruleo-sulphuric acid. The blue hyposulphuric acid is obtained by precipitating the above alcoholic solution of the ammoniacal salt by a solution of acetate of lead in alcohol, and then proceeding as for the sulphuric acid. In either, the sulphuretted hydrogen should be removed, and the liquid should not be filtered until it is perfectly blue.

The blue acids have a powerful affinity for bases, and the resulting compounds, are not to be regarded as double salts, for in the ceruleo-sulphate of baryta, the sulphuric acid exactly saturates the baryta, so that the blue colour appears to combine with the salt, somewhat like water of crystalization in ordinary salts. It will appear from this that it still remains for the chemist to determine in what manner the blue colour combines with the acids. These ceruleo-salts have all a fine blue colour, whether soluble or otherwise, taste slightly saline, and very strongly like indigo, and require a considerable amount of heat to decompose their organic colour. The sulphates of the alkalies are scarcely soluble in alcohol of 0.84, and are precipitable by colourless alkaline sulphates, and even by other salts. The corresponding hyposulphates are soluble in alcohol, and scarcely precipitated by other salts. Both series of salts, when soluble in water, leave by evaporation to dryness, an uncrystalized mass, with a cupreous metallic lustre, surpassing that of insoluble indigo-blue. The ceruleo-salts of potassa, soda and ammonia, may be prepared pure by digesting the blue wool, alluded to above, in the carbonates of those alkalies to saturation, evaporating to dryness, and treating with alcohol, which dissolves the blue hyposulphates, and leaves the ceruleo-sulphates. The corresponding compounds of lime and magnesia are prepared, as those of the alkalies may also be, by treating the solution of indigo-blue in sulphuric acid by their carbonates, and by farther separating the two series from each other by alcohol. The salts of baryta and lead may be precipitated from the soluble alkaline compounds, by solutions of those metals.

The blue colour in the two acids is susceptible of a deoxidation similar to insoluble indigo-blue. If filings of zinc or iron be placed in their solution, the metals are oxidized at the expense of the blue colour, for hydrogen is not evolved, and with an excess of acid the solution is colourless or yellowish, but instantly becomes blue by contact with oxygen or atmospheric air. It is the most delicate of all tests for the presence of oxygen gas. The blue colour is more easily reduced in the salts than in the acids, and most readily when there is an excess of base. A beautiful experiment illustrates this property. Protosulphate of iron may be dissolved in a neutral blue solution, and heated in it without inducing reduction; even a large portion of protoxide of iron may be precipitated with alkali without producing a change; but the moment we add an excess of alkali, the blue fluid instantly changes to yellow. By saturating the solution with acid, it soon becomes blue, and may again be rendered yellow by a new excess of alkali. It is remarkable that indigo-blue should suffer its

peculiar deoxidation, but more so that this soluble blue should resemble it in this feature, although differing in most others.

The blue colour is not so firmly united to the two acids of sulphur as not to form other compounds; thus by mingling chloride of calcium with a blue solution, and adding phosphate of soda, a fine blue phosphate of lime precipitates; if carbonated alkali be added, a less brilliant ceruleo-carbonate of lime is thrown down. Even tannate of oxide of lead may be obtained as a blue precipitate, by throwing acetate of lead and tannin simultaneously into the solution. It would be highly desirable to multiply experiments of such a character, as the transposition of the blue colour may yet prove of service in dyeing and printing operations.

Soluble indigo-blue is as fugitive as many vegetable sap colours, suffering alteration from the solar ray, heat, nitric acid, caustic alkalies, &c., forming new bodies which unite with the sulphuric and hyposulphuric acids, and give rise to new acids. If ceruleo-hyposulphate of baryta be evaporated to dryness in a water bath, it becomes green, and contains *virido-sulphuric acid*, which may be obtained like the blue sulphuric. If one part of ceruleo-sulphate of potassa be dissolved in fifty parts of lime-water, and heated in a closed vessel, for several hours, the solution becomes of a purplish red colour; by filtering, and passing carbonic acid through the solution, evaporating to dryness, and treating with alcohol, a small portion is dissolved with a red colour. The insoluble residue dissolves in water with a dark purple-red hue, and being precipitated by neutral acetate of lead, gives a salt containing a new acid, the *purpuro-sulphuric*. If the blue sulphate of potassa be similarly treated, in an open vessel, with lime water, the colour of the solution graduates through green, purple, and red, into yellow; but by ceasing when it is red, precipitating by carbonic acid, and evaporating to dryness, alcohol extracts a yellow compound, while the residue becomes red. Sugar of lead throws down from the tincture a citron yellow salt, containing *flavo-sulphuric acid*, while the remaining fluid is red. The red residue insoluble in alcohol, and the last red solution contains a reddish acid, which, by solution in absolute alcohol, yields *fulvo-sulphuric acid* of a reddish-yellow tint; and the residue insoluble in absolute alcohol, gives a fine red solution with water, containing the *rufo-sulphuric acid.* A cursory view of this subject might lead to the supposition that these singular, varied, and beautiful compounds, although interesting to the chemist, can never be rendered available in practical operations; but we have already too many instances in the arts of substances now employing the hands of numerous artisans, which only sprang into existence under the touch of the chemist, to listen

to such assertions. When the existence of chrome was first made known to the world, who could have imagined that it was destined to play an important part in the arts; or even when sand and alkali first fused together, by an accidental intensity of heat, who could have known that the resulting glass would eventually prove a source of many of the comforts and conveniences of mankind? Neither can we now assert that an intimate knowledge of the varied and curious properties of indigo arising from the labours of the chemist, can prove of no benefit to manufactures.

3. *Action of nitric acid on Indigo.*—This acid has a peculiar decomposing action on a variety of organic substances, giving rise to a host of new products, which are not yet well understood. Thus by its action on indigo, it produces several distinct acids, of which but little is known, not so much from a want of extended observation and experiment, as from the extreme difficulty attending such chemical investigations. If we employ nitric acid, of 1.28 sp. gr., diluted with an equal bulk of water, and add to it one part of finely powdered indigo, as fast as it is decomposed, with the assistance of warmth, two acids form in the solution, and by concentration, precipitate together in a crystalline form. By solution in boiling water, and cooling, fine needles separate, which are *nitroanilic acid*, formerly called indigotic acid. It may be purified and separated from the *nitropicric acid*, which is also formed, by boiling its solution with freshly precipitated carbonate of lead, when the nitroanilate of lead remains in solution. When purified, the acid crystalizes in fine white needles, of a strong acid taste. It combines with the alkalies, earths, and many metallic oxides, forming yellowish or reddish compounds.

The nitropicric acid may be formed more readily by digesting one part of indigo with 8 to 10 parts of moderately strong nitric acid, with the assistance of a gentle heat, and as soon as the liquid ceases to evince decomposition, and is still, by heating it to boiling, and adding, from time to time, nitric acid, as long as nitric oxide is evolved. The fluid, suffered to cool, deposites crystals of the acid, frequently called the carbazotic, and formerly Welter's Bitter. It combines with bases, usually forming yellow salts. The salt, with potassa, being rather insoluble in water, and wholly so in alcohol, this acid has been employed to detect the presence of potassa. It has also been recommended by Braconnot as a remedy for intermittent fevers. Excepting these, the salts of these two acids have received no practical application. In regard to the manner in which their elements are combined, it is difficult to hazard a conjecture; but Berzelius rather regards them as organic bases combined with nitric acid. Thus the nitroanilic acid may be represented as $(C^{14} H^{8} O^{4}) + NO^{5}$; and the

nitropicric as composed of $(C^{12}\, H^4\, N^2\, O^3)\ NO^5 + (HO)\ NO^5$; and when the latter combines with a base, as potassa, the HO, or atom of water, is replaced by that base; thus $(C^{12}\, H^4\, N^2\, O^3)\ NO^5 + (KO)\ NO^5$. It is probable that much time will not elapse ere these dark regions in organic chemistry will be illuminated by advancing science. They have been presented, as well to give a complete and yet condensed view of the subject of this essay, as to point out the numberless modifications of which a single substance is susceptible. In the succeeding part of the essay, we shall devote a few pages to the practical operations connected with indigo.

[TO BE CONTINUED.]

Report to the Trustees of the Philadelphia Gas Works, on the progress and state of the Works, January 22, 1841. *By* J. C. Cresson, *Superintendent.*

In compliance with the request of the Board, the Superintendent has the honour to present a brief history of the works from their commencement, and a view of their present operations and capacity.

Ground was broken on the site selected for the location of the works, in the month of April, 1835, about one month after the final passage of the ordinance of Councils authorizing their construction.

The erection of the buildings and apparatus, and the laying down of the main pipes in the streets, were prosecuted with the characteristic energy of the engineer, Samuel V. Merrick, Esq., and they were so far completed as to be in readiness for the manufacture and reception of gas on the 8th of February, 1836, less than ten months from their commencement; and on the 10th of February, the gasometer and mains were filled, and gas furnished for public and private lighting. The works then completed, consisted of a retort-house, 98 by 48 feet, capable of accommodating thirty retorts, and storage for 12,000 bushels of coals; a purifying and lime house, 40 by 20 feet, containing one set of dry lime purifiers; a set of vertical condensing pipes, placed on the north side of the purifying house, above ground, presenting a surface for deposite of 600 square feet; a range of buildings, 133 by 20 feet, containing office, meter room, laboratory, and workshop; and two gasometers, fifty feet in diameter, with a capacity of 35,000 cubic feet each, in tanks of masonry, entirely under ground.

The street mains laid, comprised 9140 feet of ten inch pipe, partly in Filbert, and partly in High streets, extending from the works to Delaware Second street; pipes of two, three, and six inches diameter, in some of the lateral streets, chiefly Second, Third, and Fifth streets, and four and six inch pipes in Chesnut and High streets, to the extent of 4018 feet of six inch, 9430 feet of four inch, 12,400 feet of three inch, 2310 feet of two inch, and 1354 feet of branches, making a total

of 38,652 feet, or seven and one third miles. On this extensive line of mains, only nineteen private and forty-six public lights were ready to receive gas when the works were first in a condition to furnish it. This paucity of consumers resulted, not from any indifference on the part of the public, but from the tardiness with which the few persons engaged in the business of putting up gas fittings completed their work. The usual laws of supply and demand soon called into the business many of our enterprizing mechanics, who, by their activity, were able to keep pace with the increasing calls for the means of lighting with gas; and by the close of the year it was supplied to 2800 private, and 165 public lights, consuming daily about 42,000 cubic feet. The maximum daily consumption in the first year, was 48,500 cubic feet, and the whole quantity made in 10½ months, 6,481,300 cubic feet. The progress of the demand is shown in the second column of the accompanying table, marked A.

In the course of this year, a small addition was made to the street mains of 2951 feet of three inch pipes.

At the close of 1836, authority was granted by Councils to extend the works, by means of a loan of $ 150,000; on condition, that before any dividend to the Stockholders should be declared, the sum of eight per centum on the amount borrowed for the extension of the works, should be annually set apart and reserved from the nett profits, to be applied, first to the payment of the interest on said loan, and the balance to be invested as a sinking fund for its redemption, in case the Stockholders should be allowed to retain possession of the works until the loan reached maturity; which was to be in twenty-five years. The said sinking fund, and its accumulations, to revert to the Stockholders, if Councils should take possession of the works prior to the twenty-five years, which they have the power to do at any time they may see fit. Measures were promptly taken by the Trustees to give to the public the benefit of this addition to the means at their disposal. The works were originally laid out on a plan which would admit of symmetrical enlargement, without interference with the parts already constructed; by the erection of additional sections, corresponding in exterior to the first, but entirely independent and complete in the interior arrangement and apparatus.

The first step in this system of enlargement was undertaken in the year 1837.

The retort-house was extended to nearly double its original length, and by the adoption of a different arrangement of the interior, was made capable of receiving sixty additional retorts, and furnishing store room for 25,000 bushels of coal. The bench for thirty retorts was completed at once, and the second section, thus formed, was pro-

vided with purifying and condensing apparatus, by converting the lime house into a purifying house, and fitting up therein a second set of purifiers, with a series of condensing pipes and drips against its northern flank. A range of sheds, supported on cast-iron columns, was erected against the walls which enclosed the yard, which furnished store room for 100,000 bushels of coal and coke.

Two additional gasometers, with their tanks, similar in their dimensions to those in use, were constructed; and the part of the lot thus filled up, was enclosed with a substantial brick wall.

In a word, the productive capacity of the works was doubled, and accommodations provided in part, for another section, whenever it should become necessary, and a storage of an ample supply of coals provided under cover. As the consumption of lime for purification had increased sufficiently to make it an object to produce it on the premises, a small perpetual kiln, for calcining shells, was put up, and the whole supply of lime economically obtained, by burning oyster shells with the refuse breeze from the coke. The extension of main pipes in the streets was made to keep pace with the enlargement of the works; the additions were as follows: ten inch, eighteen feet; six inch, 6984 feet; four inch, 4302 feet; three inch, 13,068 feet; two inch, 3468 feet; in all, 27,840 feet, or five and one quarter miles, making an aggregate of thirteen miles of street mains. The number of lights supplied at the close of the year, had increased to 6814 private, and 300 public lamps. The maximum daily consumption in the year was 105,500 cubic feet, and the whole quantity of gas produced in the year, 17,078,000 cubic feet, making a total production of 23,560,000 cubic feet.

Two dividends, of four per cent. each, were paid to the Stockholders this year, one of the profits earned to the first of January, in the first ten months operations, and the other, of those earned in the six months, ending the first of July.

The rapid increase in the demand for gas having more than doubled the daily consumption, and the growth being as yet unabated, with every prospect of its longer continuance, it became necessary to look to some provision of additional leading mains for the supply of the remote eastern sections of the city, and an extension of gas store room at the works. To meet these contingencies, a second application was made to Councils for authority to raise the requisite funds, by loan, and this was granted, to the amount of $200,000, upon the same conditions as were imposed on the first loan. In accordance with the system marked out, when the plan of the works was originally adopted, a sixteen inch main was carried south from the works, along Ashton street to Spruce, a distance of 2340 feet; and from this a

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twelve inch main was laid down Spruce street, from Ashton street to the Delaware, 10,881 feet. The Spruce street main was laid as far as Ninth street, a distance of 8000 feet, without any branches for lateral connexions; being designed to insure a full supply to the eastern parts of the city.

From the twelve inch main, six inch pipes were branched at Ninth, Sixth, and Second streets, to connect and complete the circulation between the two great mains on the northern and southern routes; the connexions at Sixth and Second streets were completed, and the six inch mains extended to the northern boundary of the city, at Vine street. Numerous smaller mains of two, three, and four inches diameter, were laid in different parts of the town, to accommodate the applications for gas, which continued throughout the year with scarcely any abatement in number and frequency.

The extent of mains, of various sizes, laid in 1838, was sixteen inch, 2340 feet; twelve inch, 10,881 feet; ten inch, 27 feet; six inch, 9036 feet; four inch, 14,409 feet; three inch, 15,660 feet; two inch, 150 feet; total, 52,503 feet, or nearly ten miles, which, added to those previously laid, made the whole extent of street mains twenty-three miles.

The increase in the consumption of gas continued during this year in the same remarkable ratio as in the preceding, the number of customers, and the amount of gas sold being more than doubled. The maximum daily consumption was 180,000 cubic feet, and the whole quantity made in the year, 27,357,000 cubic feet; the number of private lights, at its close, was 11,102; of public lamps, 434. Two dividends, of six per cent. each, were paid to the Stockholders, out of the profits earned, to the first of January and July of this year, and the semi-annual dividends since then have been of the same amount. The unparalleled augmentation of the demand for gas, which had hitherto been experienced, had made it necessary to continue an almost uninterrupted series of extensions of the capacities of the works, and pipes of conduit; on one occasion it was deemed most prudent to close the book for applications, lest they should increase too rapidly for the means of supply. But the establishment had now attained a magnitude which rendered it probable that the same rate of increase could not be maintained for a much longer time; and yet the additions to the number of consumers were on the increase during the greater part of the year just closed, and thus far showed no symptoms of abatement. Under these circumstances, it became a matter of no little difficulty to determine the proper rate for future extensions, so as, on the one hand, to keep pace with the wants of the public, and on the other, to avoid the unnecessary loss of interest from premature

expenditure of funds. The buildings and apparatus for the manufacture of gas, are of such a character as to require considerable preparation, and months of labour for their proper construction; and the measures to be adopted must therefore be predicated, not upon the present condition of the business, but upon its prospective condition some ten or twelve months in advance.

Upon deliberate consideration of the whole ground, it was thought most prudent to make another addition to the works in 1839, although at the close of the preceding year they were capable of furnishing some 40,000 or 50,000 feet more per day than the average demand.

Accordingly, the bench for thirty retorts, in the third section of the retort-house, was fitted up, and an addition was built to the purifying house, and furnished with the requisite purifiers, condensers, &c., to complete a third series of works, equal in capacity to each of the other two. Four additional tanks were likewise constructed, with gasometers corresponding to the four already in use; and a store cellar built alongside of the retort-house, with room for 60,000 bushels of coals. The quantity of gas produced by each section of the retort-house having been increased considerably beyond what they were originally estimated to be capable of generating; it was found that the purifying apparatus, as first arranged, was insufficient to render the gas as pure as it ought to be, and it became necessary to devise some means of adding to its efficiency, without throwing out of use the extensive fixtures which had already been constructed. This was effected by adding a second story to the purifying house, and placing on the upper floor duplicate sets of purifiers, connected collaterally with those below; which gave a double extent of purifying surface, and passed the gas at a reduced pressure, sufficiently purified, without any departure from the ground plan already adopted.

For the more perfect separation of ammoniacal deposits, which sometimes prove a source of much annoyance to the gas manufacturer, a set of large refrigerating cylinders was put up between the retort-house and condensers; these are supplied with jets of water, throwing into each cylinder about two gallons an hour; and since they have been in operation, in conjunction with the double sets of purifiers, the gas passes from the works free from any appreciable noxious impurity, even when subjected to the nicest tests of the laboratory. The means of distribution likewise received considerable additions this year; the mains laid, were eight inch, 3726 feet; six inch, 4419 feet; four inch, 11,997 feet; three inch, 11,629 feet; and two inch, 1704 feet; in all, 33,475 feet, or about six and one quarter miles, making an aggregate of $29\frac{2}{5}$ miles. The maximum consump-

tion was 207,000 cubic feet, and the whole quantity of gas made, was 39,473,000 cubic feet.

The number of lights supplied at the close of the year, 15,851 private, and 596 public.

A comparison of the operations of the works for the year 1839, with those of the previous year, shows that the ratio of increase of demand had very much fallen off, being less than fifty instead of one hundred per cent., as in former years; this may be taken as an indication that the boundaries of the profitable districts had been passed, and that future extensions would tend rather to diminish than to increase the profits of the concern. This impression has been confirmed by the experience of the next succeeding year, which has just elapsed; the increase of demand for gas being again, not only in a very much diminished ratio, but the actual excess only about one half that of the preceding year.

During the year 1840, the improvement at the works have been limited to the completion of the improved plan of the retort-house, by taking down the retort-bench of the old section, and remodeling it so as to make room for a double bench, with coal stores below, as in the section last built; a change which it was necessary to make, while the summer demand was within the capacity of one double bench with sixty retorts. The pipes laid have been only a few small sections to complete connexions, or supply applicants near the terminations of the lines.

They comprise, six inch, 261 feet; four inch, 576 feet; three inch, 1674 feet; and two inch 222 feet; in all 2733 feet; making the total length of mains 158,136 feet, or nearly thirty miles.

The maximum daily consumption of gas was 249,000 cubic feet, and whole quantity made in the year, 45,210,000 cubic feet, the number of lights increased to 19,799 private and 708 public.

These details have brought our history down to the present period; and it remains to give a connected view of the result of the transactions narrated, by a general sketch of the existing condition and capacity of the establishment.

The retort-house is a brick building, 195 feet long, 48 feet wide, and 18 feet high; covered with a roof composed entirely of iron; with an arched brick floor, resting on cast iron girders. The retort-benches are in two double ranges, placed back to back, with one horizontal flue, common to each double range; the two flues terminating in a single stack, 100 feet high, standing in the centre of the building. The whole will contain 120 retorts. The retorts are D shaped, seven feet long, two feet wide, and one foot high; and work off four hour charges of 150 pounds of coal; producing about 4,000 feet of gas in

twenty-four hours; they are set three to a fire. The standing pipes and dip-pipes are four inches diameter; the hydraulic main fourteen inches; and the general connecting pipes six inches. The gas is washed as soon as it leaves the hydraulic main; and passes from the washers to the refrigerators, which are upright cylinders, on square bases, eighteen feet high and forty inches diameter; four of these constitute a set, and are connected, so that two are collateral, and two consecutive; the connexion being through a double valve, by which one pair may be thrown out for cleaning or repair, without stopping the works.

From the refrigerators, the gas passes to the condensers, composed of a series of twenty upright pipes, eighteen feet high, and six inches diameter; standing upon drip boxes, which are drained by a connected series of syphons. The refrigerators stand on the south side of the purifying house, exposed to the weather; and the condensers on the north side, enclosed by a verandah with revolving venitian blinds, which are kept closed when the weather is severely cold. The purifiers are rectangular cast iron boxes, four feet square, and two and a half feet deep, with sheet iron caps, secured by a water lute. Three layers of lime, about three inches thick each, are placed on wicker bottoms, in each box;—eight of these boxes form one set; four being on the lower, and four on the upper floor of the building: the two boxes in the same vertical line are connected collaterally, and the gas passes through three double boxes in succession; the fourth being thrown out for the renewal of the lime: a single hydraulic valve forms the connexion for the eight boxes of one set.

Three sets of purifiers are completed, and the building is fitted for the reception of a fourth; its dimensions are eighty-five feet in length, twenty feet in width, and twenty-two feet in height, with a cellar under the whole, in which are placed the drips and syphons for the purifiers and refrigerator valves.

The range of buildings, comprising offices, workshops, and meter room, has received no exterior addition since its first erection; being as before stated, 133 feet long and 20 feet wide, constituting the front of the works on Ashton street; but two new station meters, of sufficient size to pass 10,000 feet per hour, have been placed in the meter room, and connected with the new sections of the works, so that the gas generated in each section, is separately measured; provision is made, however, for connecting either of the meters with all the sections, if necessary; and a similar precaution has been adopted in other parts of the works, so that if the condensers, purifiers, or meter of either section should need to be thrown out for inspection or repair; the gas generated in that retort-house can be passed through the apparatus of the others. The gasometers are now eight in number, with an aggre-

gate capacity of 280,000 cubic feet, and are so connected, as to work through either a single outlet of ten inches diameter, or through two independent outlets of the same size. The suspension is by three points; the chains converging to a single point, and connected to the counterweight by a cross bar.

The pulleys are supported on a triangular trussed bridging, sustained on cast iron stands eighteen feet high.

The works now completed occupy one half of the plot appropriated to their use, and are so arranged as to unite symmetrically with a similar series, to be constructed when needed, on the other half. The entire dimensions of the site are 306 feet, north and south, by 738 feet, east and west; intersected by Ashton and Beech streets, each fifty feet in width; it is bounded on three sides by public streets, and on the fourth by the Schuylkill river. One of the intersecting streets separates the gasometer yard from the offices and factory, and the other passes between the factory and the wharf front on the river. The space between Beech street and the river, is now used for the deposit of foul lime, and of shells from which the lime is made; the lime-kiln being on a portion of it: at a future day it will furnish valuable store-room for coals.

The present capacity of the works is sufficient to supply 300,000 to 350,000 cubic feet daily, with storage for 280,000 feet of gas, and 200,000 bushels of coals.

When the fourth section is completed, all the buildings for which are now provided, the productive capacity will be about 450,000 cubic feet per day.

The system of street mains consists of a sixteen inch main in Ashton street, from the works to Spruce, a distance of 2,340 feet; which is to head all the east and west mains; a twelve inch, down Spruce from Ashton street to the Delaware, 10,881 feet; a ten inch, from Ashton, down Filbert to Ninth, and along Ninth to High, and down High to Delaware Second street, 9,167 feet; these two mains being intended for the supply of the eastern part of the city, have no lateral connexions, except for services, until they reach Ninth street. There is also a main along High street from Ashton to Delaware Front street, consisting of eight, six and four inch pipes, about 10,000 feet in length; a six inch main in Chesnut, from Ashton to Ninth, and thence continued to Second, four inch, 9,500 feet; a four inch in Mulberry, from Delaware Front, to 150 feet west of Broad street, 6,000 feet; a four inch in Sassafras, from Delaware Second to Broad, about 5,300 feet; a four inch in Walnut street, from Dock to Schuylkill Seventh, about 6,000 feet; a four and an eight inch in Ceder street, from Delaware Second to Fourth, about 1,000 feet each.

Besides these leading east and west mains, several small sections have been laid in different streets to supply applications for light.

The lateral connexions embrace a three inch in Front, from Mulberry to High; a six inch on the east, and a three inch on the west side of Delaware Second, extending the whole breadth of the city from Vine to Cedar, each 5,370 feet in length; three inch on both sides of Third, from Vine to Spruce, except two small breaks, one on the west side, near Sassafras, and the other on the east side at Dock street; a three inch in Fouth street from Vine to Spruce, partly on both sides; a three inch in Fifth steet, from Sassafras to Spruce, partly on both sides, but with several breaks of continuity on both; a six inch in Sixth street, from Vine to near Pine, and connected at Pine by about 200 feet of three inch. Several squares of three inch in Sixth street, in small sections; a three inch in Seventh street, from Mulberry to Walnut; three inch in Eighth, from Cherry to south of Walnut, and from Locust to Spruce; a six inch in Ninth street from Sassafras to Locust, on the west side, and about 500 feet of three inch on the east side; several sections of three inch in Tenth, Eleventh, and Twelfth streets; a three inch in Thirteenth street, from St. John's Church, near High street, to St. Luke's below Spruce; a six inch in Broad street from Walnut to Pine, and about 200 feet of six inch south of Chesnut, both on west side; and sundry connexions of two and three inch pipes in the smaller streets and alleys. Comprising in the whole extent, of sixteen inch 2,340 feet, twelve inch 10,881 feet, ten inch 9,167 feet, eight inch 3,726 feet, six inch 24,718 feet, four inch 41,468 feet, three inch 57,982 feet, and two inch 7,854 feet—total, 158,136 feet, or within 264 feet of thirty miles.

The number of lights on these lines of mains, at the close of 1840, was, private 19,799; public, in streets 708, market houses 19, public squares, lighted only in summer, 62: making an aggregate of 20,588 lights in operation.

The whole cost of the establishment has been as follows:—

For Works on Schuylkill, - -	$237,903 28
For Street Mains, - - - -	168,957 22
For Services, - - - - -	56,135 95
For Public Lamps, - - - -	9,640 75
Total permanent investment,	$472,637 20

There is the sum of about $6000 outstanding, on account of permanent improvements, but as the stock of materials on hand is sufficient to liquidate the whole of this, it will not produce any material change in the amount above stated as the cost of the present series of Works, and means of distribution.

Annexed, are tabular statements giving a condensed view of the progressive condition of the several principal departments for each year since the commencement of operations. In statement A, is shown the length and size of main pipes laid in the streets ; in B, the number of service pipes and meters set for customers; in C, the number of public and private lights in operation; in D, the quantity of gas made in each month: and in E, the sales of gas as registered by small meters. Each private customer is furnished with a meter, placed in his premises at the expense of the Company, and his bill made out from its indications. Similar meters are placed at several of the street lamps, in different parts of the city, and their average taken as the average of the whole number of lamps.

A comparison of D and E, shows the amount of loss from leakage and waste. The large proportionate loss in the first year was caused by the filling and proof of the gasometers, and blowing out the air from the street mains, when first brought into use: and that which has since occurred, is principally due to the opening of the mains for connexions, or attachments of service pipes. When these operations have been temporarily suspended, the loss has fallen below two per cent.; a fact which proves the almost perfect tightness of the extensive line of mains with its numerous joints.

[A.]—*Length of pipe, in feet, laid each year.*

Years.	2 inch.	3 inch.	4 inch.	6 inch.	8 inch.	10 inch	12 inch.	16 inch	Total.
1835	2310	13,000	10,184	4,018		9140			38,652
1836		2,951							2,951
1837	3468	13,068	4,302	6,984					27,822
1838	150	15,660	14,409	9,036		27	10,881	2340	52·503
1839	1704	11,629	11,997	4,419	3726				33,475
1840	222	1,674	576	261					2,733
	7854	57,982	41,468	24,718	3726	9169	10,881	2340	158,136

[B.]—*Number and size of Meters set each year.*

Years.	3 light	5 light.	10 light.	20 light	30 light	45 light	60 light	100 light	Total.
1836	108	98	31	9	2	3			251
1837	301	77	19	6	2	3		3	411
1838	442	159	61	13	9	2	1	3	690
1839	421	118	75	26	6	3			649
1840	198	78	54	13	3	2		2	350
	1470	530	240	67	22	13	1	8	2351

[C.]—*Number of Lights added monthly.*

	1836.		1837.		1838.		1839.		1840.	
Months.	Public.	Private	Public.	Private	Public.	Private	Public.	Private	Public.	Private
January.				143		120	*18	511	*1	340
February,	46	529		235		185		559		338
March,		266		246		261		317		141
April,	34	515		253		207		446	6	221
May.	20	156		93	1	118		538	1	316
June,	22	139		55		192		400	7	112
July,	20	135		115		299	58	341	7	135
August,	20	193		760		378	33	389	4	193
Sept.,	3	241	36	402		333	14	533		704
October,		373	33	510	80	584	36	606	52	491
Nov.,		145	30	666	18	500		446	34	528
Dec.,		240	37	297	34	587	21	294	1	429
	165	2932	136	3775	133	3,764	180	5,380	113	3,948
			165	2932	301	6,707	434	10,471	614	15,851
			301	6707	434	10,471	614	15,851	†727	19,799

* In Market Houses.

† To these may be added sixty-two Lamps, placed in Franklin and Washington Squares in 1838.

[D.]—*Gas made at Works.*

	1836.	1837.	1838.	1839.	1840.
	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
January,		1,156,400	2,430,000	4,057,000	4,796,000
February,	205,200	1,006,200	1,980,000	3,437,000	4,082,000
March,	359,000	1,306,100	2,064,000	3,638,000	3,915,000
April,	362,300	1,104,400	1,918,000	2,862,000	3,362,000
May,	453,200	960,400	1,583,000	2,555,000	2,974,000
June,	361,600	866,400	1,471,000	2,058,000	2,454,000
July,	353,200	903,100	1,527,000	2,068,000	2,388,000
August,	442,300	1,078,100	1,669,000	2,301,000	2,506,000
September,	658,700	1,517,800	2,095,000	3,041,000	3,487,000
October,	921,200	2,119,700	2,857,000	3,801,000	4,444,000
November,	1,111,000	2,418,100	3,387,000	4,400,000	5,125,000
December,	1,253,600	2,642,000	4,376,000	5,255,000	5,877,000
	6,481,300	17,078,700	27,357,000	39,473,000	45,410,000

Total cubic feet, in four years and ten months, 135,800,000.

[E.]—*Consumption and sales of Gas in each year, in cubic feet.*

	1836.	1837.	1838.	1839.	1840.
Public Lights	978,812	1,397,687	3,013,546	6,280,654	8,028,818
Private do.	4,752,740	14,454,891	22,366,004	30,658,145	34,874,380
Works	90,000	200,000	250,000	380,000	500,000
Loss	$11\frac{1}{2}$ per cent.	6 per cent.	$6\frac{2}{3}$ per cent.	$5\frac{1}{2}$ per cent.	$4\frac{1}{2}$ per cent.
	659,748	1,026,122	1,727,450	2,154,201	2,006,802
Made	6,481,300	17,078,700	27,357,000	39,473,000	45,410,000

*Brief statement of facts, connected with the Explosion of the Steam Boiler in the Sash and Blind Factory of Messrs. Pike and Perry, of Middletown, Connecticut, with remarks upon the cause of the Accident.**

FROM THE SENTINEL AND WITNESS.

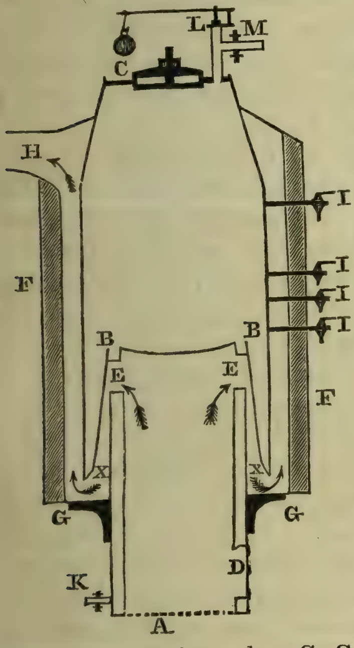
This accident occurred about half past eight o'clock on the morning of Tuesday, January 26th, 1841. The boiler which exploded was manufactured about a year ago for the Pameachy Manufacturing Company, by Guild and Douglas, of this city, and after having been in their possession about a month, it was sold to the present proprietors, who had it examined by the manufacturers, and the height of it increased, and commenced using it in June last. Since that time it has been in constant use, with the exception occasionally of a day or two. It was made of the best American iron, and was designed to be used at a pressure of about forty pounds to the square inch, but was supposed by the manufacturers, when new, to be capable of sustaining 200 lbs. to the inch without bursting.

The present engineer took charge of the engine several months since; we cannot state the precise time, but not till some time after it had been in the possession and use of Mr. Pike. And as we cannot, in giving this statement to the public—a statement which we think they have a right to demand, avoid expressing an opinion upon his conduct in connection with the catastrophe, we will take the opportunity now to say that we feel little disposition to censure him. That he is entirely free from blame we cannot affirm; but, careful as he is admitted to have been generally, as well when in the employ of others, as during his connection with Mr. Pike, it was his misfortune (as will, we think, soon be shown) to make a mistake where others, perhaps even more careful than himself, might have done the same. He affirms—and the fact so far as we know is not disputed—that some time in September or October last, during his absence a day from the shop, the person having charge of the engine allowed the water entirely to escape from the boiler, as it was found perfectly dry and leaky the next morning, and required some repairs before it could be used; and that he has been so fearful of it since that he has never ventured to risk so high a pressure upon it as he formerly did. Now it is not denied but that these facts are important, but we think other independent facts abundantly show that a very much higher pressure

* We are indebted to one of the honorary members of the Franklin Institute for forwarding this article. One of the Jury of Inquest, by whom it is drawn up, is well and favourably known for high scientific attainments. Com. Pub.

was required to produce the disrupture we have witnessed, than that to which it was ordinarily subjected. Whatever injury, therefore, the boiler may at that time have received—and we think it probably was more or less injured—we are still compelled to adhere to the opinion, that it could not have escaped its present fate, even if, at the time of the accident, it had possessed much more strength than it did when new.

But before proceeding further, in order to be understood, a description of the boiler must be given, the form of which will be seen by referring to the accompanying wood cut, which is designed to represent a section through the centre.



This boiler consisted of two parts, A, B, and B, C, each of which was six feet in height, making its whole height twelve feet. The part A, B, consisted of two concentric cylinders, one of which was placed within the other, leaving a space of two and a half inches between them to be filled with water, the cavity of the smaller constituting the furnace. At A, is the grate upon which the fire was kindled, D, the fire door, and E, E, flues, of which there were four eight inches in diameter, through which the smoke and heated air from the fire, passed, in the direction shown by the arrows. F, F, is a brick wall four inches thick, which inclosed the greatest part of the boiler, at about three or four inches distance from it, being supported by the strong cast iron plate G, G. H, flue for the smoke from the fire leading into the chimney. I, I, I, I, try-cocks, the first of which was placed six inches above the head B, B, and the others four inches apart, except the upper one, which was about a foot above the third one. The design of these was to show the height of the water, the surface of which was always to be kept above the lower, and below the upper one. These try-cocks, it will be seen, were required to be about a foot long, and were lengthened out by pieces of gun-barrel. K, pipe through which the water was forced into the boiler by the forcing pump; L, safety-valve, and M, steam-pipe, leading to the engine.

We are now prepared to understand the manner in which the explosion was produced, according to the opinion of the jury of inquest, and, it is believed, the unanimous opinion of persons who have critically examined the facts.

The explosion, as already remarked, occurred on Tuesday morning, January 26. The engine had not then been used, nor the boiler heated since the preceding Wednesday; and though the engineer, as usual, examined the boiler before kindling the fire, and, as he thought, found sufficient water in it to allow the engine to be started without pumping in any by hand, the probability is he was deceived, there being, in fact, but little in it. The probable cause of his mistake will be shown hereafter. It is not necessary to start any hypothesis to account for the fact of the water's being so low in the boiler at this time; if it was at the ordinary height when the engine was stopped on the Wednesday night previous, much of it might have escaped by a very small leak, in five and a half days.

The fire, as usual, this morning, was kindled with pine shavings, and pieces of boards, which not unfrequently produced such a blaze that it extended quite out of the top of the chimney. Being in a hurry to get the steam up, the engineer employed one of the hands to help him blow the fire a few minutes by hand, as he had done at other times. At length, by trying the safety valve, he found the pressure sufficient to commence running the engine, though not so high as they usually raised it before starting. Both pumps were started with the engine, one of which pumps the water from the well into the cistern, and the other from the cistern, into the boiler. The explosion took place about twenty minutes after the engine started.

Now if our supposition with regard to the small quantity of water in the boiler, when the fire was kindled, is correct, by the time the engine was started the parts immediately above the water must have been much heated; but would be gradually cooled as the water rose by the working of the pump, the steam in the boiler all the time increasing very rapidly. In the mean time the hot blast from the fire being driven fiercely by the blower (which forced the air in under the grate,) through the flues, E, E, would be heating intensely the part B, X, quite around the boiler, on which the water must have been suddenly dashed as soon as it rose to the edge B, to be converted into steam with explosive violence. The effect was much the same as if a quantity of gunpowder had been exploded in the boiler. The safety valve, under such circumstances, would afford no relief; and the result we have witnessed was the inevitable consequence. The engineer was probably deceived as to the height of the water in the boiler by the peculiar construction of the try-cocks, which, as we have

seen, passed through a brick wall four inches thick, and the space between this and the boiler, being nearly a foot in length. They were, of course, capable of containing considerable water, especially if they declined a little outward as it is believed they did; and this will probably account for all the water that was obtained from them that morning. If they were emptied once, being colder than the boiler, the steam, as soon as it formed, would be condensed in them again, and water might be drawn from them several times, successively. True, the engineer affirms he was aware of this, (which we are not disposed to dispute) and took the necessary precaution to avoid such a mistake, but though we give him full credit for honesty in making the statement, we think we are warranted in adhering to our own opinion. Indeed, in the hurry and bustle which confessedly occurred that morning in getting up the steam, it is not so much to be wondered at that the mistake should be made.

The rupture took place by the tearing of the iron around the edge at X, chiefly on the inside, but a part of the way the pieces separated directly at the edge, by the removal of the heads of the rivets and enlargement of the rivet holes. We are inclined to the opinion that the peculiar form of the boiler rendered it liable to yield here first, independently of the supposed fact of its being very considerably heated at the time of the accident, which must necessarily weaken it still more. The iron itself, in the opinion of competent judges, shows unequivocal indications of having been at a high temperature; and is rent and torn in such a manner as clearly to indicate the enormous force that was required to produce the effect.

The boiler seems to have yielded all around very nearly at the same time, and the part thrown off, was, therefore, thrown nearly perpendicularly upward. The slight inclination it took to the north-east may have been occasioned by its yielding a little sooner on one side than it did on the other, or by the resistance it met with in passing through the floor and roof of the building in which it was situated. On one side, four feet of the edge, where the rupture occurred, is fairly rolled up in the form of a cylinder.

The part of the boiler thus thrown from the building is computed to weigh about 1,500 or 1,600 pounds, and fell at the distance of ninety feet from its original position. So many different opinions have been expressed with regard to the height to which it rose, that means have been taken to determine it as accurately as possible, by actual measurement. Several persons saw it while in the air, some, when at its highest point, and others as it was falling; but without some mark by which to designate its actual position either at its culminating point, or some other precise point of time, it is difficult now

to ascertain the angle of elevation. One observer at the creek saw it under such circumstances, that he could scarcely mistake in identifying its true angle of elevation when at the highest point, which, by measurement, is found to give a height of 223 feet above the ground at the factory. According to the observations of others, who, however, saw it under less favourable circumstances, its greatest height would seen to have been something less than this. On the whole, we shall not exceed the truth in saying it rose from 200 to 220 feet.

Some attempt has been made to determine the height to which it rose by ascertaining the time it was in the air; and this method would be very correct if the time could be determined accurately. This, however, is very difficult, as under such circumstances it is nearly impossible for persons to form any opinion of the lapse of time, and are always prone to over estimate it. In the present instance, some persons who heard the explosion, and either heard or saw the boiler strike the ground, thought it must have been in the air a minute, others, half a minute, and others estimated it at only a quarter of a minute, but the last estimate would have given it a height (making no allowance for the resistance of the atmosphere,) of more than 900 feet. It probably was in the air about seven and a quarter seconds.

But our article is increasing to an undue length, and we refrain from adding more, except merely to say, that in preparing it we have had no personal or party purposes to serve. Our statement is made with the best of feeling towards all parties concerned. The facts stated, with the exception of one or two unimportant points, which will not be disputed, were fully established before the jury of inquest. If they do not seem to any one fully to confirm our opinion of the cause and manner of the accident, we may be allowed to remark that there are many other facts and considerations, all of which tend to confirm our views, that cannot be compressed into a single article like the present.

We have been assisted in determining the height of the boiler, by Prof. A. W. Smith.

JOSEPH K. F. MANSFIELD,
JOSEPH BARRATT,
JOHN JOHNSTON, } Committee appointed by the Jury of Inquest.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

[Translated from the German, by L. Klein, Civil Engineer.]

[continued from page 173.]

LETTER X.

Cape May, New Jersey, July 29, 1839.

My ninth letter, dated from Cincinnati, contained a description of the rail roads in Belgium, and a comparison of the same with those in the United States;* in the present, I intend to give a sketch of the rail roads in the other parts of Europe.

1. *Rail Roads in Austria.*

The first rail road constructed in Austria for the transportation of passengers and freight, is that between the Moldau and Danube, or from *Budweis to Lintz;* the project for the same originated in the proceedings of the commissioners from the ten States bordering on the river Elbe, who met at Dresden in 1819, in consequence of the congress act of Vienna, and held a convention for the regulation of the navi gation upon the Elbe. The free navigation upon this river commenced in 1821, and the commission at Dresden had, before its dissolution, applied to the Austrian government with the request, to regulate also the navigation of the river Moldau as far as Budweis, and to establish from that point to the river Danube, a canal or rail road, in order that goods may be transported upon this line of communication from Hamburg to the Danube, and back. In the year 1822, I was requested by the President of the Court of Commerce, to place myself at the head of this undertaking, and proceeded immediately to make the local reconnoissences. I then went to England to consult there upon the best plan of locating the rail road over the mountains which divide the waters of the Moldau and Danube, and which have an elevation of 1000 feet above the surface of the water on the one, and of 1500 feet on the other side.

At that time, the engineers in England were unanimously of opinion that every rail road which leads over a mountainous country, must be composed of horizontal or nearly horizontal sections, connected by

* This letter the author has translated into English, at the request of some friends of internal improvements, to whom the contents were shown; it was afterwards, in consideration of the important information it embraced, republished in the Journal of the Franklin Institute. See page 145, vol. xxiv.—2d series.

steep inclined planes, which are to be worked by stationary steam engines. My explanation, that I regarded a rail road, in the principles of its construction as well as its ultimate objects, as nothing more than a very good turnpike road, and therefore could, in no case, agree to the adoption of inclined planes, was entirely disregarded.

I returned from England in November, 1822, superintended, during the following two years, the necessary surveys, and obtained, on the 7th of September, 1824, from His late Majesty, Emperor Francis I, a charter for the construction and management of a rail road between the Moldau and Danube. In March, 1825, I formed a company of stockholders in Vienna, and completed, up to the end of 1828, the first thirty-nine miles of this road from Budweis to the summit. The principles upon which this section was constructed, were, to have no greater ascent than forty-four feet per mile, (1:120,) and no smaller radius of curvature than 622 feet; finally not to lose again any ascended height. As the road was intended principally for the transportation of salt, the superstructure was made of wood, with flat bars fastened upon longitudinal sills, and the adopted maximum rise was founded upon the experience, that the railway cars, as they were then constructed, commenced at that inclination on plate rail roads, to descend by their own gravity. In the fall of 1828, the section of thirty-nine miles was opened, and used, as intended, with horse power.

Plain as these principles of construction must appear to every body, and though their results realized all expectations, propositions were made for altering the same, and adopted by the directors of the company without further inquiry. I therefore once more explained in a report, published in February, 1829, the motives for adhering to the former principles, and proposed, at the same time, the introduction of light locomotive engines for carrying on the transportation on this road; but my propositions were disregarded by the directors, who prefered to have the other section of the road, from the summit to Lintz, constructed on a plan in which grades of 115 feet per mile, (1:46) were adopted for considerable distances, ascended heights were lost again, (the road was made undulating,) and curves with radii of sixty feet were frequently introduced. In the year 1832, the whole line of eighty miles in length was put in operation, and since that time, has been used without interruption, in summer and winter, although the country is covered with snow through five months in the year. The company had formerly let the transportation of salt and merchandize to a contractor, who received three kreutzer in silver per 100 lbs., on those thirty-nine miles of road, the construction of which I had superintended; this is equal to one and one quarter cents per ton, per mile; after the opening of the whole line, never less than

ten kreutzer was paid for double the former distance, or eighty miles, which is at the rate of two cents per ton per mile; and there can hardly be any body, from the engineer to the cart driver, who, in passing over this rail road, does not sincerely regret, that the principles adopted in the construction of the first half of it, were not adhered to in the construction of the other half. The company would thereby have saved at least one cent per mile for every ton of goods transported, which, for 25,000 tons, per annum, would amount to 20,000 dollars, while the additional cost of the road, if constructed according to my principles, would have been only 120,000 dollars; besides it is now impossible to use locomotive engines upon this rail road, which would be of the greatest advantage, since wood is so cheap in this section of country. There certainly exists no other rail road, neither in Europe nor in America, on which the principles of construction were so different in its two halves, and where the consequences are at the same time so apparent; and it is to be wished for the sake of instruction, that a great many persons may visit this road, and convince themselves of the results of both plans of construction.

Under these circumstances, it is surprizing that this rail road, which has cost 800,000 dollars, or 10,000 dollars per mile, has paid, since its opening in 1833, *five per cent.* annually, on the capital expended in the construction, although only 6000 passengers, and 25,000 tons of goods, (principally salt,) are conveyed annually, over the same. If 925,000 dollars, or 11,562 dollars per mile, had been expended for the construction, the profit would have been six and one half per cent., and with the application of locomotive engines, perhaps eight per cent. on the cost of construction. The stockholders of this rail road labour under the disadvantage that a part of the capital was obtained in loans on short terms, while another part was received for shares, sold below their par value; the dividends for the first subscribers are thereby lessened, and will be sufficiently large only after the debts are liquidated.

The rail road from Budweis to Lintz, was afterwards continued to the salt depots, in Gmunden, and forms now an uninterrupted line of 130 miles in length, which has been for three years in full operation. The plate rails of this road are of the same dimensions as on many of the American rail roads, upon which locomotive engines are used without difficulty; but unfortunately, the road from Lintz to Gmunden has also been constructed upon such principles as will exclude the use of locomotives for ever. The total cost of the whole rail road of 130 miles in length, is 1,170,000 dollars, or 9000 dollars per mile, which appears very low, considering the great number of bridges and frequent rock excavations. Upon the road from Lintz to Gmunden,

95,000 passengers, and 40,000 tons of goods were conveyed last year, and the income, on the same, is therefore far greater than on that from Budweis to Lintz.

In the year 1826, the construction of a rail road *from Prague to Pilsen*, in Bohemia, was commenced; it was intended for the transportation of wood from the forests of Prince Turstenberg, and of coal from the vicinity of Pilsen; the length of the projected line was eighty miles; the limited means of the company, however, allowed only the construction of the first thirty-five miles, and the rail road was then publicly sold, to pay the debts of the company. At present, the rail road is used only for bringing wood and building materials to the city of Prague. I here take occasion to remark, that I have never been in any connection with this work.

The public, in Austria, expended for the above named rail roads, of 165 miles in length, about 1,500,000 dollars, at a time when the other States of Germany had not even thought on the introduction of rail roads. By the construction of this road, which, in part, traverses very difficult sections of country, they have acquired in Austria an experience, which, if judiciously applied, must be followed by the best results; and already these rail roads have called forth those undertakings, which are, at present, executed in Austria on a much larger scale than in any other State in Europe.

The first great rail road now in progress in Austria, called "*Emperor Ferdinand's North Road*," extends from Vienna to the salt works in Bochnia, (Galitia,) and will be 310 miles in length; the section from Vienna to Brunn, of 100 miles, is already opened, and they are actively engaged in the prosecution of the work. Last year, the directors of the company estimated the cost of construction of this rail road, at 20,000 dollars per mile, it will, however, not fall short of 25,000 dollars per mile, or of 7,750,000 dollars for the whole line. As the greater part of this capital is already paid in, the whole road will undoubtedly be completed in the course of a few years. The continuation of this line to *Cracow* will then likely follow, and for a rail road from *Cracow to Warsaw*, the Russian government has already granted a charter.

The second important rail road now under construction in Austria, is that from *Vienna to Raab*, (in Hungary,) which, with the branches to Baaden, Glocknitz, and Oldenburg, will have a length of 170 miles. With the considerable amount of capital at disposal, it may be expected that this rail road will also be completed within a few years.

At this moment, there may be 300 miles of rail roads in operation in Austria, and double as many miles will be in operation in the course of three years.

2. *Rail Roads in the other German States.*

Besides the rail roads in Austria, the following have been established in Germany, for the transportation of passengers and freight, and are partly in operation:

1. The *Nuremberg and Furth Rail Road,* four and one half miles in length, though very short, gave, nevertheless, for the stockholders, the best results ever obtained on any rail road in Europe. The population of Nuremberg, is only 38,000, that of Furth, 25,000, and the number of passengers upon the rail road, were:

In 1836,	449,399;	the dividends,	19 per cent.
" 1837,	469,304;	"	17½ "
" 1838,	439,889;	"	17 "

2. The *Berlin and Potsdam Rail Road,* fourteen miles in length, has cost 1,000,000 dollars; it has been opened, partly, on the 21st of September, 1838, and in its whole length, on the 29th of October, 1838. Up to the 29th of December, of the same year, the number of passengers transported, were 102,119. This rail road will, if well managed, give very favourable results.

3. The *Leipzic and Dresden Rail Road,* of 71½ miles in length, was opened on the 8th of April, 1839. The capital stock is 3,150,000 dollars, and the company had, besides, the right to issue bank notes to the amount of 350,000 dollars. The great cost of this rail road, which will not be short of 50,000 dollars per mile, has its cause in the great unevenness of the country through which the road has been located; but on the other side, a very great traffic may be expected upon it. Although only six miles of this road were opened on the 24th of April, 1837, and afterwards merely small sections at both ends, the number of passengers has been:

From 24th of April to 31st of December, 1837, -	145,674
In the year 1838, - - - -	365,870*

4. The rail road *from Brunswick to the Hartz,* is constructed by government, and will be thirty miles in length. The section from Brunswick to Wolfenbuttel, of eight miles, was opened on the 6th of December, 1838, and the number of passengers, to the end of that year, was 24,600.

5. The *Dusseldorf and Elberfeld* rail road, of thirteen miles in length, is undertaken with a capital of 700,000 dollars. Unfortunately, at the advice of the engineer, Robert Stephenson, an inclined plane was made in the middle of this road, which, as I have formerly observed, is in contradiction with the experience in America. On the

* According to a report lately published by the Directors, there were transported over the Leipzick and Dresden rail road, during the year 1839, 411,531 passengers, and 131,936 cwt. of merchandize, the total receipts were 262,282 dollars.

20th of December, 1838, the section from Dusseldorf to Erkrath was put in operation.

6. The *Magdeburg and Leipzic rail road* is seventy-five miles long, and constructed with a capital of 2,000,000 dollars; a part of this road will be opened in the course of this year, the remainder, in 1840.

7. The rail road *from Cologne to the frontier of Belgium*, forty-three miles in length, is located through a very difficult section of country, and its cost is estimated at 3,500,000 dollars; the completion of this road may not take place before two or three years. Cologne will then have a rail road communication with the harbours of Ostend and Antwerp, (in Belgium.)

8. The *Munich and Augsburg* rail road, forty miles in length, is constructed with a capital of 1,200,000 dollars, and will be completed in the course of the year.

9. The *Taunus rail road, from Frankfort to Mentz*, and Wiesbaden, is undertaken with a capital of 1,300,000 dollars, and will be twenty-six miles in length; it will likely be completed in the spring of 1840.*

10. In the Grand Duchy of *Baden*, a very extensive rail road is now under construction, through the whole length of the State, at the expense of the government, and as, at the same time, a rail road is constructing through Darmstadt, there will be, within a few years, a continuous rail road from Frankfort, on the Main, to Basle, in Switzerland.

There are some other small rail roads in different parts of Germany, upon which, however, nothing but coal, iron ore, &c., is transported.

The cost of construction, and even the length of the above named rail roads, cannot be accurately stated, as scarcely any of the lines is entirely completed, or, at least, buildings, locomotives, cars, &c., are still wanted on them. The average of the cost of the several rail roads, as above stated, is 47,000 dollars per mile; but when they are all in full operation, their cost will be found to amount to 50,000 dollars per mile; and perhaps to more. The cost of a mile of rail road, with a single track, in Germany, is, therefore, two and a half times greater than in America. If we take into consideration the extremely low wages of all classes of workmen, in Germany, but at the same time, also, the greater unevenness of the country, and compare both with what they are in America, we cannot but regard the works in Germany as very expensive, and I must, after mature deliberation, refer again to those causes by which the American rail

* A part of this road, from Frankfort to Hoechst, was opened in September, 1839, and the whole line in April, 1840. Up to the 1st of July, the number of passengers were 281,510, yielding an income of 50,000 dollars.

roads are so much cheaper, and which were stated in my fourth letter. It is for the fear of a too great expenditure, that no other rail roads are now undertaken in Germany, and that so many good and useful projects were abandoned. Amongst the projected rail roads, with the locality of which I am somewhat better acquainted, I mention the *Rhine and Weser*, the *Berlin and Stattin*, and the rail road from *Berlin to Frankfort, on the Oder.* These lines might, with the assistance of the great experience acquired in America, be constructed for such sums as would insure a good profit to the stockholders.

3. *Rail Roads in France.*

The most extensive rail road line in France, is that from *Lyons to Roanne*, which was constructed by three companies, and is thirty-eight lieues in length; the Epinac rail road is six and one half lieues, and the Paris and St. Germain rail road four and three quarter lieues long, while the total length of the other rail roads in operation, will hardly amount to eleven lieues; France has, therefore, at present, only sixty lieues, or 150 miles of rail roads in operation.* The most expensive of these roads is that from *Paris to St. Germain*, which is only 18,400 metres, or 11½ miles in length, and has cost 14,860,000

* The following is a list of the rail roads in France, at the close of 1839:

a.) Rail roads completed.	Length in metres.		Miles.
From St. Etienne to Andrezieux,	22,000	or	13,66
" St. Etienne to Lyons,	58,000	"	36,02
" Andrezieux to Roanne,	67,000	"	41,61
" Nimes to Beaucair,	24,000	"	14,90
" Montbrison to Montrond,	15,500	"	9,62
" Paris to St. Germain,	18,400	"	11,43
" Paris to Versailles, (right bank,)	18,572	"	11,53
" St. Vaast to Denain,	8,900	"	5,53
" Cette to Montpellier,	27,000	"	16,77
" Mulhouse to Thann,	19,660	"	12,21
" Creusot to the Canal du Centre,	10,000	"	6,21
" Villers Cotterets to Port aux Perches,	8,155	"	5,06
" Epinac to Bourgogne Canal,	28,000	"	17,39
" Alais to la grand Coule,	18,000	"	11,17
Total,	343,187	"	213,11
b.) Rail roads in progress, from Nimes to Alais,	46,319	"	28,77
From Paris to Versailles, (left bank,)	18,630	"	11,57
" Bordeaux to La Teste,	51,000	"	31,68
" Abscou to Denain,	5,940	"	3,69
" Strasbourg to Basle,	140,000	"	87,00
" Paris to Orleans,	120,000	"	74,53
	381,889	"	237,24

francs, or, per mile, 242,000 dollars. The part within the city of Paris, was, of course, the most expensive, but even after deducting the length and cost of this section, we find 165,000 dollars as the cost per mile, for the other part of the road, with a double track. Of the *Lyons and St. Etienne* rail road, which has also two tracks, the cost per mile, was about 70,000 dollars.

Upon the Paris and St. Germain rail road, 1,375,396 passengers were conveyed, from the 26th of August, 1837, up to the 25th of August, 1838, and the total receipts have been 290,834 dollars, or, per mile of road, 25,448 dollars; this gross income, per mile, is eight times as great as that upon the American rail roads, where it averages only 3075 dollars; but compared with the capital of construction, the gross income, in America, is fifteen per cent., and on the Paris and St. Germain rail road, only ten per cent. The French rail roads pay like the diligences, (stages,) ten per cent. of the gross income, as a tax to the State; the expenses of managing these roads, will, therefore, not amount to less than two thirds of the gross income, and the Paris and St. Germain rail road will hardly yield an interest of four per cent., if the traffic does not materially increase.

These are the causes why the rail roads projected in the spring of 1838, from Paris to Havre, from Paris to Orleans, and from Strasburg to Basle, for which the concessions were given by the Chambers, find so little support from the public, in France, that these projects will, it is likely, be entirely abandoned. The great mass of the population in France, is poorer than that in Belgium; and as the Belgian rail roads, with an average cost of 45,000 dollars per mile, yield only five per cent. on the capital of construction, the rail roads in France ought not to be constructed for more than 30,000 dollars per mile, if the capital of construction shall yield five per cent. interest. But to arrive at this, the principles of construction, hitherto followed, as also the now existing revenue laws in France, so injurious to every enterprize, require a thorough reform.

4. *Rail Roads in Holland.*

If the establishment of the rail roads in Belgium, belongs to the remarkable events of the age, it is still more the case with the rail roads in Holland. This interesting country is known to be intersected by navigable canals in every direction, and nowhere are better and more carefully maintained turnpike roads to be found. Nevertheless, the construction of a rail road from *Amsterdam to Harlaem* was commenced two years ago, and was nearly completed, when I visited Holland, in May, 1838, with the intention to inspect the large works of draining, which were undertaken near Gouda. The con-

struction of this rail road is the more remarkable, as there is between Amsterdam and Harlaem, a canal, upon which passenger boats are running, and close to it, a turnpike road. A width of track of four feet eight and one half inches, like that of the English railways, was intended for this rail road; but when it became known that the St. Petersburg rail road has a width of six feet, and the rail road from London to Bristol, even of seven feet, it was established by a decree of the government, that all the rail roads in Holland shall have a clear width between the rails of two metres, or six feet six and three quarter inches.

For a second rail road, from *Amsterdam to Arnheim*, along the Rhine, the concession was given by His Majesty, King William, with a guaranty not before heard of in any work of this kind; the King declared himself ready to guaranty to the stockholders, with his own private property, a dividend of four and one half per cent. per year. It is unnecessary to mention, that the whole capital was instantly subscribed.

[TO BE CONTINUED.]

Extracts from the Second Report of the Directors of the New York and Erie Rail Road Company, to the Stockholders, February 3rd, 1841. *Signed, by order of the Board of Directors, by* ELEAZAR LORD, ESQ., *President of the Company.*

CONTINUED FROM PAGE 194.

Of the Probable Income of the Road.

Instead of proposing simply an estimate of the probable number of passengers on this road, connected as it is, at its extremities, with the greatest sources and facilities of travel in the country, and throughout its whole extent, with tributaries from the right and left, or of the quantity of tonnage it may command, it seems appropriate to observe, that it occupies a route which is exempt from all hazard of competition; that it will accommodate an extent of country far larger than that which supplies the business of the Erie canal; that it is adapted to the object of tonnage as well as to that of travel; that besides the ordinary products of agriculture and manufactures, it will have large resources of business in the transport of minerals and lumber; and that the population within such distance of it, as to be relied on for its support, will not be less numerous than that which contributes to the toll, freight, and travel, on the Erie canal, and the works near its borders.

To illustrate the consideration last above mentioned, the following statements are submitted in the belief that the results will justify the utmost confidence in the productiveness and value of the work.

Statement of the population, by the census of 1840, of the counties traversed by the road, and of adjacent counties, and parts of counties,

to which it will be the most convenient route of communication with the city of New York.

Counties through which the Line extends.

Rockland, - - - -	11,874	
Orange, - - - -	50,733	
Sullivan, - - - -	15,630	
Delaware, - - - -	35,363	
Broome, - - - -	22,348	
Tioga, - - - -	20,350	
Chemung, - - - -	20,731	
Steuben, - - - -	45,992	
Alleghany, - - - -	40,920	
Cattaraugus, - - -	28,003	
Chatauque, - - - -	47,641	
		340,385

Adjacent Counties in the State of New York.

Two-thirds of Otsego, - -	44,248	
Chenango, - - - -	40,778	
Cortland, - - - -	24,605	
Tompkins, - - - -	38,113	
One-third of Cayuga, - -	16,787	
One-third of Seneca, - - -	8,289	
Yates, - - - -	20,442	
One-quarter of Ontario, - -	10,875	
One-half of Livingston, - -	17,855	
One-half of Genesee, - - -	28,305	
One-quarter of Erie, - -	15,788	
		266,085
		606,470
Adjacent border counties of Pennsylvania, viz:—Erie, Warren, McKean, Potter, Tioga, Bradford, Susquehanna, Luzerne, Wayne, and Pike, and parts of some others; and in New Jersey, parts of Sussex, Passaic, and Bergen, estimated at - - - - - -		230,000
		836,470
Under the influence of the construction and use of the road, the increase in the above counties, in the next five years, may be safely estimated at 20 per cent. or - -		167,294
		1,003,764

The foregoing statement is made with reference to the state of things when the road is completed, and comprises considerable numbers within this State, which at present contribute to the support of the Erie canal, through the Chenango and Chemung canals, and by various land routes; for all which there is room for adequate allowance in the ensuing calculations.

By the census of 1830, it appears that the number of inhabitants in the above mentioned counties, and parts of counties, in this State, was - - - -	477,823
Increase in ten years, 27 per cent., or - - -	128,627
	606,450

The increase in the State at large, during the same period, excluding the city of New York, was 23¼ per cent.; and in the city of New York, 50½ per cent.

In the eleven counties traversed by the road, the number of inhabitants in 1830, was - - - -	262,433
Increase in ten years, 30 per cent., or - - -	77,952
	340,385
The number of acres of land taxed in the aforesaid counties, and parts of counties, in this State, in 1839, was	8,781,765
The number of acres taxed in the canal counties, and parts of counties, represented in the following statement, was, in 1839, - - - - - -	6,631,955

Statement of the population in 1840, of the counties which are traversed by, and other counties and parts of counties, which now are, and will, it is assumed, continue after the road is completed, to be tributary to the Erie canal.

Schenectady, - - -	17,233	
One-third of Otsego, - - -	17,124	
Montgomery and Fulton, - -	43,839	
Herkimer, - - - -	37,378	
Oneida, - - - -	85,327	
Madison, - - - -	40,067	
Oswego, - - - -	43,820	
Onondaga, - - - -	67,914	
Two-thirds of Cayuga, - -	38,575	
Two-thirds of Seneca, - - -	16,579	
Wayne, - - - -	42,160	
Three-fourths of Ontario, - -	31,876	
Monroe, - - - -	51,912	
One-half of Livingston, - - -	17,855	
Orleans, - - - -	25,015	
One-half of Genesee, - - -	28,305	
Niagara, - - - -	31,114	
Three-fourths of Erie, - - -	46,615	
		677,708

The number in the same counties, and parts of counties, in 1830, was - - - - - -	548,205
And in 1835, the number was - - -	646,197
Increase in ten years, from 1830 to 1840, 23½ per cent.	
Increase in five years, from 1835 to 1840, 5 per cent.	
With an increase of 5 per cent. in the next five years, the number will be - - - - -	711,593

If to 677,708 be added the inhabitants of the city and vicinity of

Albany, say 32,292, making 710,000, an increase of 7 per cent. thereon in five years, will make an aggregate, in round numbers, of 750,000.

The very moderate increase above noticed, of 5 per cent., between 1835 and 1840, is most probably to be accounted for, by supposing that the effect of the canal in drawing population within reach of its facilities, and in enhancing the price of farm lands from four or five, to fifty, eighty, or a hundred dollars per acre, according to position, had been realised prior to 1835; while the extraordinary increase of thirty per cent. in ten years, in the counties on the line of the road, indicates that the anticipation of that work, added to the very low price of lands in those counties, had induced emigration thither.

If to the population to be immediately accommodated by the rail road as above stated, viz: - - -	836,470
be added that of the city of New York, in 1840, viz:	312,832
and that of Brooklyn and vicinity, say - -	45,718
The aggregate will be - - - -	1,195,020
The increase of which, in the next five years, supposing the road to be completed and in full operation within that period, may be safely estimated at 25 per cent., making in round numbers - - -	1,500,000

It is, therefore, abundantly manifest that a population not less, but more numerous than that by which the canal and its route is used, is to be accommodated, and relied on for the support of this road.

Now the tolls annually collected on the Erie canal and its branches, exclusive of the Champlain canal, amount in round numbers, to - - - -	$ 1,500,000
The cost of freight on the canal is, at least, three times as much as the tolls, or - - - - -	4,500,000
The amount of fares paid by the population using the canal for passage in boats, and on the rail and other roads along its route, cannot be estimated at less than three dollars each per annum. The population using the canal route at the present time, may be estimated with sufficient accuracy by adding to the number in the canal counties as above stated, viz. in 710,000, for those from other counties and parts of counties, who, through branch canals and otherwise, now use the route of the Erie canal more or less, both for travel and transport, a number equal to about one half of the 606,450 assigned to the rail road within this State, making in round numbers $ 1,000,000; which at three dollars each, amounts per annum, to - - - - - -	3,000,000
Total, - - - - - -	$ 9,000,000

which is equal to an average of nine dollars each, per annum, for travel and transport on that route, or about 12 per cent. of the value of the commodities transported.

In 1839, 1,435,713 tons were transported on the canals, valued at $ 73,399,764, on which the tolls received amounted to $ 1,616,382, of which $ 113,753 were collected on the Champlain canal.

The tolls actually collected on the canal, being the basis of this estimate, and the results being, after large allowances, sufficient to justify the inferences to be made from them, it is immaterial whether the numbers stated as now using the canal, or the rates of fares paid, be exact or not. No reason is perceived why it may not be safely taken as a basis of calculation with reference to the rail road and Southern tier of counties. The inhabitants of those counties are not less industrious or less enterprizing than those of the counties which border the canal. Their lands, for all the purposes of agriculture, with exceptions in respect to wheat, are superior to those of the canal counties; their climate is more uniformly salubrious; and in their rivers, their forests, and their minerals, the difference is still more widely in their favour. If there be a reason, it is not apparent, why they should not have occasion to travel as much, and as far as their Northern neighbours, to procure for themselves a like quantity of supplies, and to pay for them by sending their products to market; or why they should not be able and willing to pay as much annually, for travel and transport, if favoured with facilities adapted to all their objects, interests and wishes, and available from the Atlantic to the lake, in winter as well as summer. If the products of their agriculture are at present less, their lumber and their minerals are far more abundant. The railway will, to say the least, furnish them facilities of travel and transport as much more eligible and convenient than any others within their reach, as the canal and the road, along its route, do those using and supporting them. For through passengers passing West from the city of New York, and East from the lakes and Western States, the prospects of the road cannot be well deemed inferior to those of the canal route, whether distance, time, expense, or comfort be most regarded.

There would seem, then, to be nothing very extravagant in anticipating for this road, which will be competent to as much business, and combines all the objects of the canal and the rail and other roads on its borders, an amount of income not vastly disproportioned to the amount paid for tolls, freight, and travel on that route, as above represented.

To those, however, who may think it most prudent to suppose the inhabitants of the Southern counties to have fewer wants than their neighbours, less ability to supply them, and less occasion and leisure for travel, it may be more satisfactory to estimate their payments for the same objects, at six, or at four and a half, instead of nine dollars each, per annum. At six dollars each for 800,000, the amount would be $4,800,000. At four dollars and fifty cents, it would be $3,600,000.

Supposing then that a single track of the road finished in the best manner, with a heavy edge rail, and competently furnished with engines, cars, and all the requisite appurtenances, should cost $9,000,000, the above estimate of six dollars for each inhabitant, deducting one-third, or $1,600,000 for expenses, which is deemed more than sufficient for such a road, would give an annual net income, on the cost, of thirty-five per cent. At four dollars and fifty cents each, the net income would be over twenty-six per cent. per annum. If only three

dollars each be assumed, which would require the supposition that the travel and business of this population, would be but one-third as much as that on the route of the canal, the net income, after deducting one-third for expenses, would amount to about eighteen per cent. per annum.

To judge of the claims of any such undertaking, and especially of rail roads, because they offer the greatest facilities for travel, and likewise for transport, when properly constructed for that object, it is essential to inquire, first and chiefly, to what number of people will the work in question afford the most satisfactory means of travel and business. This may involve two subordinate inquiries; one, whether, and to what extent, the route is exposed to competition; the other, as to the tendency of the work to augment and multiply the employments and business of those who are relied on for its support, and to attract farther accessions to the population.

Where there are people enough for its support, a road adapted to their purposes, and so conditioned as to command their patronage, will, of course, be productive. The number of people to be served is, in connexion with the length of the road, a far safer basis of calculation than any general or theoretical estimate of passengers and tonnage. There may be a great difference on different routes in the variety and extent of the employments and business of the people; and a more numerous population may be required on some routes than on others, to afford daily a sufficient number of passengers, in addition to their tonnage, to support a road. On a route through a salubrious and inviting country, occupied by a prosperous and increasing population, and affording scope and objects for ten times their numbers, a railway is a far safer investment than on a route which, though equally populous at the outset, presents no new objects of enterprise, or inducements to immigration. On a road long enough to yield, on an average, five dollars for each passenger, two hundred passengers a day, with their tonnage, would probably yield a better income on the same capital, than twenty-five hundred per day, on a short road, yielding but fifty cents a passenger. A road requires a given number of passengers yearly, with their tonnage, to render it productive. If there are on its route people enough, their character, circumstances and employments being considered, to supply that number of passengers, and if growing numbers and patronage are in the given case to be relied on, in connexion with the use and influence of such road, its success is certain.

Such a case is presented by this road. There is no mode of estimate or calculation on such a route, occupied by such a population, that will not justify all that need be claimed or presumed for this.

One consideration has, however, been omitted, which merits notice, and which, from its important bearing on the subject, did not escape the attention of the intelligent and practical men who have added most liberally to the subscriptions of the past year—namely, that on all that portion of the cost of the work which is discharged by capital borrowed, the annual dividend is limited by the rate of interest on the loan—consequently the dividends on the company's

stock will be larger in proportion as the earnings of the road exceed the rate of interest on the loan. Thus, if the income of the road is equal to ten per cent. on its cost, it will pay six per cent. on two-thirds of the amount, and eighteen per cent. on the balance.

Aware of the operation of this method, and of the security it gives at once to stockholders and to the lenders of capital, railway companies in England, in cases where the density of the population insures an abundant income, even on roads costing ten to twenty times as much per mile as this will cost, and where they find no difficulty in disposing of their stock to any required amount at a premium, limit the issue of shares to a portion of the expenditure, and supply the balance by loans.

It may still be gratifying to some to have before them an estimate of the number of passengers required at a given charge for fare to support this road.

If then there should be, including way and through passengers, a number equal to one hundred and five through each way per day, making for both ways sixty-six thousand a year, at twelve dollars each for four hundred and fifty miles, or about two and a half cents per mile, the receipts would amount to - - - - -	$792,000
And if the interest on $6,000,000, at 5½ per cent., be deducted, viz. - - - - - -	330,000
The remainder - - . - -	$462,000
will divide over 15 per cent. on $ 3,000,000 of stock.	
At eighteen dollars each, or four cents per mile, the balance will divide 28 per cent. on $3,000,000.	
If the number of passengers be equal to one hundred and fifty through each way per day, or one hundred thousand a year, the receipts at twelve dollars each for fare, would amount to - - · - - -	$1,200,000
and interest be deducted as before - -	330,000
The remainder - - - - -	$870,000
will divide 29 per cent. on $3,000,000 of stock.	
And at eighteen dollars each, the balance will divide 49 per cent. on the stock.	
Should the city of New York, the counties on the route, and the regions beyond, furnish passengers equivalent only to fifty through each way per day, or thirty-three thousand a year, the receipts at eighteen dollars each, or four cents per mile, the rate usual on other roads, would amount to	$594,000
interest being deducted as above - - -	330,000
The balance - - - - -	$264,000
will divide 9 per cent. on $3,000,000.	

As an illustration of the matters involved in these estimates, it may be observed that on the Utica and Schenectady railroad, seventy-eight miles in length, the number of through

passengers, in 1839, was - - - -	95,776
and of way passengers - - - -	86,823
Total - - - - -	182,599

equal to 125,102 through passengers; the fare through being three dollars, or a fraction short of four cents per mile. It is understood that the passengers transported on that road are estimated at not more than one-fourth of the whole number that pass between Utica and Schenectady, on the canal and otherwise, per annum.

The expenses of the year amounted to less than 30 per cent. of the receipts. The balance, after deducting all expenses, amounted to more than 15 per cent. on their capital. Had half of their capital been borrowed at 6 per cent., the earnings of the year, after paying the interest on the loan, would have divided 25 per cent. on the stock; or paid off the loan in four years of like receipts; or divided 10 per cent. per annum, and paid off the loan in six years.

The number of through passengers, as stated above, divided by the number of miles in the road, gives an average equal to 1604 passengers per mile yearly, 134 per mile per month, and 31 per mile per week.

100,000 through on this road would give 224 passengers per mile yearly, 19 per mile per month, and 4½ per mile per week.

66,000 through would give 147 passengers per mile yearly, 12 per mile per month, and 3 per mile per week.

33,000 through would give 73 passengers per mile yearly, 6 per mile per month, and 1½ per mile per week.

On the Boston and Worcester road, forty-one miles in length, the average in 1839 would be 2195 passengers per mile yearly, 183 per mile per month, and 42 per mile per week.

On the Boston and Lowell, twenty-six and a half miles in length, in 1838, 4905 passengers per mile yearly, 409 per mile per month, and 94 per mile per week.

On the Camden and Amboy, sixty-one miles in length, in 1839, 2984 passengers per mile yearly, 249 per mile per month, and 57 per mile per week.

Utica and Syracuse, fifty-three miles in length, in 1839, 2302 passengers per mile yearly, 192 per mile per month, and 44 per mile per week.

The number of way passengers on the Utica and Schenectady railroad amounted, in 1839, to 86,823.—The gross revenue derived from them was $87,979 57, amounting to $1.01 for each individual; and as the charge for a through passenger is three dollars, it is seen that the way passengers traveled, on an average, one-third the length of the road. It may be assumed as nearly self evident, that in a country occupied by a population distributed evenly over its surface, and having a uniformity of character and pursuits, the railroads which traverse it will receive numbers of way passengers proportional to their

lengths; that is, a straight road two hundred miles long will have twice as many way passengers as a road one hundred miles long. If we apply this principle to the case of the New York and Erie railroad, we may estimate the number of its way passengers from that on the Utica and Schenectady road, in the following manner, viz:

Miles. Miles.
78 : 446 : : 86,823 : 496,449 = number of way passengers on the New York and Erie railroad. If we suppose the distance traveled by the above number of persons to be the same in proportion as on the Utica and Schenectady railroad, the average journey for each will be one hundred and forty-eight miles. At four cents per mile the sum paid would be $5.92, and the amount per annum received from all the way passengers would be $2,938,978.08.

To illustrate this view of the subject still farther, we will make a similar estimate from data furnished by the Utica and Syracuse railroad. The length of this work is fifty-three miles; the number of way passengers in 1839 was 55,802, who paid on an average seventy-three cents each, the price for a through passage being two dollars. By extending the calculations as above, we shall find that the number of way passengers on the New York and Erie railroad would, at the same rate, be 469,579, and the sum received from them, $3,056,959.

The amounts obtained in these calculations agree sufficiently to show that with regard to the railroads cited, the rule that the numbers of way passengers are as the lengths, holds good.

The mean of the two results is about $3,000,000, from which, if we were to deduct one-third for expenses, we would have a net receipt of $2,000,000 on way passengers alone; equal to 22 per cent. on the capital; or if two-thirds of the cost of the work were defrayed from loans, at 5½ per cent., the income on the remaining $3,000,000 of stock would be 55 per cent. per annum. In other words, if the New York and Erie railroad shall receive as many way passengers in proportion as the Utica and Schenectady, and Utica and Syracuse railroads, the net earnings might be more than sufficient to pay 5½ per cent. on $6,000,000 of loans, and 50 per cent. on $3,000,000 of stock, and this without taking into account the profits on through passengers, on freight or on the transportation of the mail.

Nothing can illustrate more forcibly than this the advantages which long roads possess over short ones. The results obtained may seem extravagant, and it is not intended to be asserted that they will from the first be realized; but when it is remembered that the Utica and Schenectady railroad has, to the north of it, a country which, as yet, yields very few passengers, and that on the south side it is in immediate contact with the Erie canal, which, during seven months of the active portion of the year, divides with it the way business, and that the Utica and Syracuse railroad, having the same competition with the canal to sustain, has also the inconvenience of being constructed for nearly half its length across swamps which are at present uninhabitable, whereas the New York and Erie railroad is every where free from these disadvantages, it cannot be deemed unreasonable that we

should expect to profit to a very considerable extent from the principle above set forth.

The Boston and Lowell road is one of the best in the country, and is worked as cheap, or cheaper, than any other, in proportion to its length. But it is short, and notwithstanding its heavy business, both in passengers and tonnage, pays but about nine per cent. per annum on its cost.

Of the railroad stocks in England, which are offered for sale, as quoted in the London Mining Journal, Railway and Commercial Gazette, of the 26th of December, 1840, all those which appertain to railways, of which the length is thirty miles or more, and which have been completed and in operation one year or more, are at a premium, viz:

Stockton and Darlington, 38 miles, including branches; opened, 1825; price, £275 per £100 paid up, premium, 175 per cent.

Liverpool and Manchester, 31 miles; opened, 1830; price, £185 per £100 paid up; premium, 85 per cent.

Grand Junction, 82½ miles; opened, 1837; price, £212 per £100 paid up; premium 112 per cent.

London and Birmingham, 112 miles; opened, 1838; price, £169 per £90 paid up; premium 87½ per cent.

London and Southwestern, 76¾ miles; opened, 1838 and 1840; price £54 per £30 paid up; premium, 40½ per cent.

Great Western, 117½ miles, of which 63½ are finished; opened, 1838 and 1840; price, £89 per £65 paid up; premium, 37 per cent.

New Castle and Carlisle, 61 miles; opened, 1839; price, £105 per £100 paid up; premium, 5 per cent.

The stocks of a number of other roads which exceed thirty miles in length, up to one hundred and twenty-six miles, are quoted at various rates below par, but most of them are but partially constructed, and none of them had been completed and opened prior to 1840.

Of the numerous roads which are less than thirty miles in length, the stocks, without exception, are quoted below par.

Analogous to this, is the experience on this side of the Atlantic. Though the cost of roads here is comparatively small, and their character as to routes, grades, curves, and superstructure, is quite various, it is believed that not more than two or three that are forty miles or more in length, and have been finished and in use twelve months, are unproductive; among which, the only one in New England, or New York, is that from Stonington to Providence. Their earnings vary from 6 to 15 per cent. Some shorter roads are known to be productive, but it is deemed quite safe, and due to the subject, to state that of the roads which are completed and in use, those which are not productive are short ones.

The report of the Western railroad corporation of Massachusetts, dated March, 1840, states that the net income of the railroads, finished in that Commonwealth, averages over 8 per cent. per annum on their cost.

In 1839 the net income of the Utica and Schenectady road was 15 per cent.; of the Utica and Syracuse, 14 per cent.; of the Camden and Amboy, 13¼ per cent.

The foregoing estimates of passengers on this road, are made on the supposition that the freight both ways would pay the repairs and all other expenses, which may be taken at one-third of the receipts, or assuming the largest of these estimates, at $400,000 a year.

On the Erie canal, in 1839, about 160,000 tons of merchandise, products of animals, seeds, &c., were transported, of the value of $45,000,000, as stated in the report of the commissioners; and about 340,000 tons of manufactures, vegetable food, &c., exclusive of lumber, valued at $17,000,000, making 500,000 tons of the above mentioned articles, valued at $62,000,000.

The 160,000 tons of merchandise averaged in value $280 per ton and would, it may be reasonably presumed, be transported on a railway properly constructed for tonnage, in preference even to an adjacent canal, on account of its value, the difference of time occupied in its passage, certainty of calculation as to its arrival, less risk of damage, convenience in respect to the engagements and affairs of those owning it, and other considerations of more or less force in different cases.

The 340,000 tons of manufactures, &c., averaged in value about $50 per ton, and would assuredly be transported on a railway on the shortest route to market were there no canal on such route.

Let it then be supposed, that of the above descriptions of articles, quantities should be transported on this road, equal only to 100,000 tons through per annum, and that the rate of profit on the transit of them should be one per cent. per ton per mile, the net receipts in such a case would be $450,000, or more than enough to defray the supposed amount of annual expenses.

Or if by being in operation five months of the year more than the canal, 50,000 tons of merchandise for the interior of this and the western and southwestern states, should be transported over the road at a profit of two cents per ton per mile, the like sum of $450,000 would be received.

It is therefore deemed as plain as success elsewhere or here can make it, that excluding all reliance on lumber, coal, and other minerals, there is room for the highest confidence of an abundant income. It is believed, however, that when the road is in full operation, from 100,000 to 200,000 tons of coal, and a like quantity of lumber, will be transported on it, on an average 150 miles; and that the number of passengers and the whole amount of tonnage will very far exceed the highest of the preceding estimates.

Architecture.

On Glass as applied to Architecture.—Extract from a Lecture on the Architecture of the Middle Ages, delivered before the Franklin Institute, by T. U. WALTER, *Professor of Architecture, December* 10, 1840.

"The first ancient writer by whom any mention is made of glass as an artificial substance, is Theophrastus, who wrote about 300 years before Christ; he describes it as having been made of the sands of the river Belus, and seems to have had considerable knowledge of its nature. About a century later, we have a description of the celebrated *sphere* of Archimedes, which, if the account of it be true, goes to show that the art had then attained to considerable perfection.

Lucian speaks of drinking glasses, and Plutarch, Lucretius, Virgil, Horace, Strabo, Seneca, and Pliny, all mention glass; indeed Pliny, who wrote in the 77th year of Christ, gives a full description of the way in which it was then manufactured; he says that some forms were brought into the required shape by blowing with the breath, some were ground on a lathe, and others were embossed—Sidon, he tells us, was formerly famous for these manufactures, and *specula*, or looking-glasses, were first invented there. He further remarks, that no substance was more manageable in receiving *colours*, than glass, and that it might be cut, or engraved upon by diamonds. The Apostle Paul also alludes to glass, in his first letter to the Corinthians, written about the year 57, and the language he uses clearly indicates it to have been a substance through which objects could not be discerned with distinctness.

We have no positive authority relating to the use of glass for *windows*, earlier than the close of the third century. St. Jerome, who wrote in 422, speaks of windows formed of glass melted and cast into thin plates; and in the year 571, Gregory of Tours alludes to the devastations committed on the windows of churches, by the ravages of war. Johannes Philoponus, who is supposed to have written about the same time, speaks of the panes of glass being fastened in the windows with plaster.*

Felibien, in his "*principes de l'architecture,*" says that the first attempts at ornamenting windows with figures, were made by arranging glass of different colours, like mosaic, and that the beautiful effect thus obtained, led gradually to the art of infusing various tints into each pane, so as to produce compositions of any required design.

Fortunatus, who lived towards the end of the sixth century, speaks

* Rees' Cyclopædia.

in glowing terms of the painted glass in the windows of the church of Notre Dame, at Paris; and Benedict Biscopius is said to have imported the art into Britain in the year 675.

Stained glass was not, however, connected with architecture to any great extent, until the reign of the third Henry in England, in the thirteenth century, and it reached its zenith under the kings of the house of York, in the fifteenth century.

A popular idea prevails that the art of staining glass was lost, but such is not the fact. When architecture began to decline, under the Tudor family, all the arts connected with it declined also, as a natural result. Felibien, who wrote as long ago as the year 1699, says, that in ancient stained glass, some very beautiful and very lively colours are seen, which are not now to be found; it is not, however, that the invention is lost, but because persons will not incur so great an expense, or take the same pains to make them, that they formerly did.*

Dallaway says, very plainly, that the idea of the art having ever been lost, "*is a vulgar error,*" it is practised at the present day as perfectly, and as beautifully, as in any preceding age.†

From this cursory glance at the introduction of glass in building, we find that architecture went through all its earliest stages in the east, attained the zenith of its glory in Attica, and sunk in ruin with the city of the Cæsars, before glass was used at all as a material for keeping out the weather, and transmitting light; hence *classic* architecture ran its whole course without any influence whatever from this invention; while, on the other hand, *Gothic* architecture depends for *its* character almost exclusively upon it. To the introduction of glass in building, may, therefore, be attributed much of the wide difference which exists between classic and gothic architecture."

Franklin Institute.

Minutes of the Board of Managers.

At a meeting of the Board, held at the Hall of the Institute, January 17th, 1841,

Mr. James Henry Bulkley was elected Chairman, and

Messrs. Henry Troth and John S. Warner, Curators, for the ensuing year.

At a meeting of the Board, held February 17th, 1841, the Chair-

* Felibien's principes de l'architecture, p. 182.

† Dallaway's Discourses upon Architecture in England, p. 63.

man nominated the Standing Committees agreeably to the By-Laws. On motion—Alfred L. Elwyn, M. D., was added to the Committee on the Library; Professors Jas. C. Booth and Jno. F. Frazer to the Committee on the Cabinet of Minerals; Messrs. Thomas S. Stewart and John M'Clure to the Committee on the Cabinet of Models; Professors James C. Booth and John F. Frazer and Mr. Joseph Saxton to the Committee on the Cabinet of Arts and Manufactures; Messrs. Samuel V. Merrick and Matthias W. Baldwin to the Committee on Publications; Professor Henry D. Rogers to the Committee on Instruction; Professor Roswell Park, Robert Hare, M. D., John K. Mitchell, M. D., Mr. Joseph Saxton, Mr. Andrew M. Eastwick, and Professor John C. Cresson to the Committee on Monthly Meetings; Gouveneur Emerson, M. D., Mr. Sears C. Walker, and Professor Roswell Park to the Committee on Meteorology; when the Committees were appointed as follows:

On the Library.

Henry Troth, *Chairman*,
Isaac Hays, M. D.,
Isaac P. Morris,
Ambrose W. Thompson.
Thomas U. Walter,
Alfred L. Elwyn, M. D.

On the Cabinet of Minerals.

Charles B. Trego, *Chairman*,
Isaiah Lukens,
Abraham Miller,
Samuel Hufty,
Henry D. Rogers,
James C. Booth,
John F. Frazer.

On the Cabinet of Models.

Isaac P. Morris, *Chairman*,
John Agnew,
Andrew M. Eastwick,
Thomas U. Walter,
John H. Towne,
Thomas S. Stewart,
John M'Clure.

On the Cabinet of Arts and Manufactures.

James C. Booth, *Chairman*,
Alexander Dallas Bache,
Charles B. Trego,
John Struthers,
John H. Towne,
Edwin Greble,
John F. Frazer,
Joseph Saxton.

On Publications.

John C. Cresson, *Chairman*,
Isaac Hays, M. D.,
Samuel V. Merrick,
Alexander Dallas Bache,
Matthias W. Baldwin,
Isaac P. Morris,
Ambrose W. Thompson.

On Premiums and Exhibitions.

Thomas Fletcher, *Chairman*,
John Struthers,
John Agnew,
John S. Warner,
John Gilder.

On Instruction.

Alex. Dallas Bache, *Chairman*,
Frederick Fraley,
John Wiegand,
Charles B. Trego,
Henry Troth,
Henry D. Rogers.

On Monthly Meetings.

Roswell Parke, *Chairman*,
Alexander Dallas Bache,
Robert Hare, M. D.,
John K. Mitchell, M. D.,
Joseph Saxton,
Andrew M. Eastwick,
William H. Carr,
John C. Cresson,
George Taber,
John H. Towne,
James Hutchinson.

On Meteorology.

Gouveneur Emerson, *Chairman*,
John C. Cresson,
Sears C. Walker,
Henry D. Rogers,
Roswell Parke.

On Finance.

Samuel V. Merrick, *Chairman*,
Frederick Fraley,
Abraham Miller,
Matthias W. Baldwin,
Henry Troth.

Managers of the Sinking Fund.

Samuel V. Merrick, *Chairman*,
Frederick Fraley,
Matthias W. Baldwin.

Auditors.

Isaac B. Garrigues, *Chairman*,
William H. Carr,
Ambrose W. Thompson.

(Extracted from the minutes.)

J. Henry Bulkley, *Chairman*.

William Hamilton, *Actuary*.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1840.
With Remarks and Exemplifications by the Editor.

1. For a *Self-tending Saw Mill;* Edwin Moody and Samuel Morrill, Andover, Merrimac county, New Hampshire, February 8.

Several patents have been granted for objects similar to that had in

view by the patentees of this mill, namely, to perform all the motions necessary in setting the log, and actuating the other parts of the machine, without labour on the part of the tender, whose only business will be to place a new log on the carriage, and to remove the stuff as it is sawn up. The manner of doing this is, in the present instance, represented in twenty-two figures in the drawings, and the claims are to a number of special arrangements, referred to by letters, and not, therefore, affording, if given alone, any idea of the means by which the design is carried out.

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2. For machinery for *Sawing Stone;* David V. Rannells, Washington, Mason county, Kentucky, February 8.

This machinery is intended for sawing stone either into square, cylindrical, or columnar, blocks. Many machines have been contrived for this purpose, both in ancient and modern time. The patentee is limited, therefore, in his claims to the special arrangements devised by him. These we shall not attempt to describe, for two reasons; first, from the difficulty of doing so, clearly, without the drawings; and secondly, because we do not perceive in this machine any thing that is likely to bring it into extended use, if into use at all, excepting for the purpose of essaying it. We have seen marble sawed cylindrically, but so far as our observation and information extend, machines for this purpose are rarely used, although descriptions of them are to be found in the books, and this would not be the case were they found to save labour.

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3. For *Dressing Mill Stones;* Robert M. Smith, Rutherford county, Tennessee, February 8.

This patent is taken for the particular manner of laying out the furrows, the claim being to "the giving to all the furrows the same draft, as described; and also in giving the furrows a crook, or elbow, at a point about midway between the verge, or periphery, and the eye of the stone, for the purpose, and in the manner, described." Numerous patents have been taken for modes of laying out the faces of mill stones, most of which, undoubtedly, have been indebted for their supposed value to the imaginations of their contrivers, as they have not gone into extended use; such, we apprehend, will be the fate of that before us.

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4. For *Preventing and Checking Fires;* L. Bush, administrator of Isaac Lowell, Pendleton, Niagara county, New York, February 12, not issued until October 16.

The patentee tells us that the nature of his invention "consists in taking water from a cistern, reservoir, well, or from any other source, and conducting it by pipes, over, in, through, and upon, any and every portion or section of a building, internally and externally, in such a way as that in a few minutes the whole surface, externally and internally, may be covered with water, and a constant flow of water be

kept up for any length of time, by receiving the water back into the reservoir, and using it over and over again;" and all this to be effected by a machine which "for buildings of ordinary height may be worked by one man. Two men can work a machine calculated for the highest building."

The foregoing reminds us forcibly of the announcements made by the Marquis of Worcester in his "Century of Inventions," but we are not, in the present instance, as in the case of the Marquis, left to invent the machine over again, as, for our perfect edification, we have it described and represented in drawings. We cannot give the views, or speculations, of the inventor, at any extent, but he tells us that the "*simplicity*" of his machine "is such that the whole expense of one will be trifling, compared with the expense of any machine now in use, designed for the same purpose, and will bring it within the means of almost every person to have one permanently attached to his building." "The inventor claims as new, and as his invention, the arranging of pipes along the roofs of houses, having apertures to admit of the water flowing out upon the roof, for the purpose of extinguishing fires; the water being forced into said pipes by a double acting force pump, as described, or by any other means substantially the same."

The reader who does not perceive the absolute absurdity of the foregoing plan, by which one, or two, men are to deluge a building with water, both internally and externally, has not yet mastered the horn books of mechanics, and hydraulics, and such we cannot take the time to instruct. One of the most amusing parts in the whole matter is the idea of collecting the water that has been once used to extinguish a fire, and of using it over again. The modus is not given.

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5. For improvements in *Buckles, Clasps, Hooks and Eyes, &c.;* William Church, a citizen of the United States, residing in Great Britain, February 18.

"These improvements consist, in the first instance, in the adaptation of a lever to the buckle, as a substitute for a pointed tongue; and in the second instance, in the adaptation of a spring stop to a clasp, catch, or other fastening, for the purpose of retaining the connexion between the two parts when united, or in a holding position." "The improvements in clasps, catches, hooks, or other such fastenings, consist in the adaptation of a spring stop, having a double inclined plane, which, when the two parts of the clasp or other fastening are put together, shall prevent their separation until a force is applied sufficient to push the staple past the inclined part of the spring." The devices proposed to be used are represented in twenty-nine separate figures in the drawings, the claim, however, is a very limited one, being to "the application or substitution of the lever which pinches, or presses, the strap, in place of the ordinary tongues, or points, entering, or piercing, the strap, or bandage, as has been the case heretofore."

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6. For a *Portable Grist Mill;* Isaac Straub, Cincinnatti, Ohio, February 18.

"My first improvement consists in the addition of an elastic bridge tree to the ordinary bridge tree, by which the spindle is raised and lowered, which additional bridge tree I usually make of a strip of wrought iron. My second improvement consists in the manner of affixing and running the spindle, said spindle being sustained by a permanent step at its lower end, and by an adjustable quarter bush at its upper end; there not being any bush, or support, between its two extremities."

The claim is to "the additional bridge tree, made of wrought iron, or other elastic material, having on its upper side the step of the spindle, its ends being attached to the base of the frame, and the raising and lowering of it being effected by the ordinary bridge tree, in the manner set forth."

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7. For constructing *Ships, Brigs, &c.;* George F. Bigelow, Norfolk, Virginia, February 18.

The following is the substance of the specification of this patent, that part only being omitted which consists of references to the drawings, and which are not necessary to a clear understanding of the proposed plan.

"Be it known that I have invented an improvement in the manner of contructing ships, brigs, and vessels of all kinds, either for sea or river service, by which improvement they are, whether large or small, built upon an established principle, which, it is believed, will be found in practice to furnish vessels which will pass through the water with less resistance, and to possess greater stability, than those built upon any other plan.

"The principle upon which I proceed and upon which my improvement rests, is that of making all the water lines of my vessel of whatever kind it may be, segments of circles. In carrying out this principle rigidly, the stem and stern, or fore and aft parts of my vessels will have the same form, and the greatest breadth of beam will be exactly amidships. Should it, however, be desired to have the greatest breadth of beam either forward, or abaft, of this point, it may be effected to any desired extent by adopting two different curves in each of the water lines; in which case the shortest end will become a segment of a curve of smaller radius than that of the longer end; the variation of the radius being governed by the distance to which the greatest breadth of beam is removed from midships; a variation which will not, in the slightest degree, affect the principle upon which I proceed, namely, that in passing through the water, the lines by which said water is divided by the forward part of the vessel, and those also by which it flows in towards the stern, shall both, whatever may be the draft of the vessel, be simple segments of circles.

"Although it is not absolutely necessary to the carrying out of my principle of construction, that the stem and stern posts should rise vertically, or nearly so, from the keel, I prefer so to plan them, as by this means a greater degree of strength may be attained, and I am well assured that a vessel so formed, will pass through the water

with equal facility as one under the ordinary construction. This observation applies more particularly to the stem of the vessel, or cut-water, as usually formed.

"Having thus fully described the nature of my invention, and shown the manner in which I carry the same into operation; what I claim as constituting my improvement, and desire to secure to myself by letters patent, is the so constructing of ships, and all other vessels, either for sea or river service, as that all the water lines, from stem to stern, either from midships, or from that part having the greatest breadth of beam, shall consist of segments of circles, as herein set forth."

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8. For a machine for *Cutting Veneers;* William R. Greenleaf, and Alonzo C. Gerry, in the Town of Gerry, Chatauque county, New York, February 18.

The veneers are to be cut in this machine by means of a long stiff knife, fixed obliquely across a sliding gate; and the patentees say, "we are well aware that machines with sliding gates, and knives, for cutting shingles, staves, and other kinds of thin stuff, are in use, but they are not capable of cutting the kind of veneers referred to, in consequence of the knives not being sufficiently stiff, or unyielding; in this respect, we believe, our machine differs very essentially from all others; and also in the construction of the feeding works." The claims are to the method of holding, and adjusting the piece from which the veneer is to be cut, by means of sharp pointed, and blunt screws. The mode of bringing the stuff forward, and the mode of setting the knife by socket set screws.

This machine can be applied to short stuff only, being limited to the convenient length of the knife, which must, of necessity, operate across the grain. It is proposed to steam the wood, and this would, undoubtedly, be necessary in all curley stuff. The general construction of this machine not being new, the claims, it will be seen, are limited to matters of detail, giving but little security, as there would be no difficulty in varying these so as to avoid all interference.

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9. For *Oiling Mill Spindles;* Elijah W. Welsh, Paris, Fauquier county, Virginia, February 18th.

This patent is taken for an improvement on a former patent, dated January 28th, 1840. In the additional specification, we are told that "the oil is admitted through an aperture closed by a screw; or it may be admitted through the collar;" and the claim is to the "mode of oiling the necks and bushes of mill spindles; that is to say, by the described combination of the circular box, hollow stem, and hollow spindle neck, with the square fountain containing the oil and bush."

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10. For *Measuring for Garments;* Daniel Williams, city of New York, February 18th.

This patent is also for an improvement upon the plan for which a

former patent was granted, dated the 26th of April, 1839. The claim made is to "the combination of the graduated slide, and segment, with the instrument originally patented, substantially as the same is described, such combination being intended to indicate the proper position of the upper point of the fore part, shoulder seam."

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11. For *Saddles with elastic Seats;* Charles King, Mount Pleasant, Jefferson county, Ohio, February 21.

In this saddle there is a flat plate spring placed behind the cantle, and attached thereto at its middle; its two ends rising to a distance from the cantle. These ends are connected by screw rods and nuts to two girths, which pass along to the fore part of the saddle tree, under the seat; these girths may be tightened by means of the nuts upon the rods, which pass through the cantle for that purpose. The ends of the springs are covered, and hidden, by leather casings behind the cantle, which may be opened when it is desired to regulate the force of the springs. The claim is to "the mode of connecting the springs behind the cantle with the webbing within it, and regulating the tension of the same by means of the ⊥ bolts passing through the cantle and spring, with the nuts on the ends thereof, as set forth." This is a more neat and simple, and, we think, a more effective mode of forming a spring saddle, than most of those which have been previously patented.

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12. For a machine for *Punching Iron;* Samuel Davis, Mifflin, Juniata county, Pennsylvania, February 21.

This machine is intended, principally, for punching sheet iron for manufacturing stove pipe. A follower, carrying a series of punches, is brought down by means of a combined lever and cams. The perforated dies upon which they operate, are in separate pieces, and they, and the punches, may be renewed at pleasure. The claim is to the special arrangement of the respective parts, as described, there not being any novelty in the general plan of operating a number of punches at the same time.

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13. For a *Lime Kiln;* Isaac Richardson, Paoli, Chester county, Pennsylvania, February 21.

This kiln differs from many others only in the manner of arranging the flues, as indicated in the claim, which is to "the manner of constructing and combining the flues below the ash pit, so as to admit the air at the back as well as at the front and sides, in a lime kiln for burning anthracite on grate bars, by natural draft; governed as set forth, the other parts of the kiln being constructed substantially, as described."

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14. For a machine for making "*Wrought Iron Spikes;*" John M'Crone, Ellicott's Mills, Baltimore county, Maryland, February 21.

"The general arrangement of this machine does not differ materially from some others, and I therefore do not claim it as of my invention, but what I do claim, is the gripping of the spike upon the two stationary dies, by the two movable dies, with the arrangement for removing it, when completed, by the action of the finger; constructed, combined, and operating, in the manner set forth. Also the particular arrangement and combination of the heading apparatus, consisting of the lever, working shaft, and slide, operating by a crank on the end of the main shaft, as set forth."

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15. For an improvement in *Weaver's Harness;* John Thorp, and William G. Angell, Providence, Rhode Island, February 26.

This patent is obtained for an improved manner of using the knotted heddle stuff, of which weaver's eye harness is made. The claim is to "the chain of knotted heddle stuff of which weaver's harnesses are intended to be made, as described, also the connecting by knots, or half knots, the two pieces of wire, so as to form eyes suitable to be used in making weaver's eye harness."

The subject is not illustrated by drawings, yet it seems to be a case which "admits of drawings." We must suppose, however, as it has been passed by the office, that the thing patented did not admit of being drawn, and that the description, although to us somewhat obscure, would be clear to a professional weaver.

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16. For an *Endless Chain Bucket Wheel;* John Dutton, Jr., Aston, Delaware county, Pennsylvania, February 26.

This patent is obtained for a proposed improvement on a plan of using an endless chain of buckets, attached to a band, or strap, and passing around two drums, in the manner of flour mill elevators. The improvement, so called, consists in making the front of each bucket double, a space being allowed between the two metallic plates of which it consists; this opening is to operate like a funnel, for the purpose of conducting any water which may spill over from the front edge of any one of the buckets, into that immediately below it. The claim is to "the construction of the spout on the outside of each bucket for preventing a waste of water, by conducting that which runs over the edge of the bucket after it is filled, to the bucket below." This is a claim upon which to obtain a patent, but as the general plan has been found inferior to the employment of an overshot wheel, which it is intended to supersede, we apprehend that the *improvement* will not suffice to bring it into general use; the complexity of this apparatus, and its consequent liability to get out of order, which have condemned it for more than a century, still remaining.

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17. For a machine for *Raising Stumps;* John D. Akin, Columbus, Warren county, Pennsylvania, February 26.

The claim to this machine is limited to "the employment of an eccentric wheel for bringing the machine above, or moving it from, a stump, in a sideway direction; constructed, and operating, as de-

scribed." The general plan of applying power by means of a windlass and chain, is that adopted, and in a way which does not present any thing of a novel character; the eccentric wheel, which is the only thing claimed, does not appear to be a very important feature in the machine, and the purpose for which it is used may be equally well attained without it.

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18. For a *Truss for Hernia;* Moore R. Fletcher, Boston, Massachusetts, February 26.

The plan of adapting the pad to the ruptured part, which is the main subject of this patent, does not differ materially from the manner of adjusting truss pads, to the particular case of the wearer, which has been before employed; but the difference has been deemed sufficient to justify its being made the subject of a patent, the claim under which is to "the attaching of the pad spring to a wheel, as described, and by this means rendering the pad movable, so that it can be placed in any required position. Also the mode of varying the amount of pressure on the pad, by means of the screw passing through the rivet and pressing against the pad spring. Also the combination of the spring rider with the wheel and pad spring, and their further combination with the truss spring. The whole being constructed, and operating, as set forth."

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19. For an *Excavating Machine;* Joseph Hanchett, Coldwater, Branch county, Michigan, February 28.

"The nature of this invention consists in combining together a common wagon, with a rising and falling frame containing ploughs for loosening the earth, and turning the same into the buckets of a revolving vertical wheel placed behind the forward plough, and at the side of another plough; which wheel elevates the earth and deposites it at the side of the excavation, or into a box or receiver on said wagon, or into a cart. Also in shaping the side of the ditch by trail cutters behind; the whole being drawn forward by animal power." The claim is to "the before described combination and arrangement of the elevating wheel, ploughs, adjustable frame, and inclined trail cutters, for excavating and cutting ditches."

This plan will, we are convinced, add another to the many abortive attempts which have been made to construct excavating machines for ditching and embanking, or for loading the excavated earth into carts, or other vehicles. We are aware that there are in operation some very useful machines for excavating, but we do not know of any completely successful effort to accomplish the purposes proposed by that before us. The object is one of great importance, particularly in the prairie regions, and there are several individuals now at work seeking to obviate the objections to the machines heretofore essayed. We think that they are, in general, aiming at more than they will be able to effect, but doubt not that some valuable improvement will be made in this department of engineering.

Specifications of English Patents.

Specification of a patent granted to Rice Harris, *of Birmingham, for certain improvements in Cylinders, Plates and Blocks, used in Printing and Embossing.* [Enrolled, Nov. 12, 1840.]

This patent is,—1st, for the manufacture of cylinders, plates, and blocks, made of, or coated with glass, enamel, or other vitrified substances, containing silica, boracic acid, or either of them, sufficient to render such cylinders, &c., capable of being acted upon by hydrofluoric acid, alone or in combination with ammonia, or other base. The cylinders thus produced, being used for printing or embossing of linen, woollen, silk, or other similar fabrics. 2nd, the application of tubes or linings for cylinders made of copper, brass, or other expensive materials, for the purpose of economising those metals. The glass cylinders, &c., are made in the following manner; twenty-eight parts (by weight) of clean Isle of Wight sand; thirty-five parts of red lead; fourteen of soda ash; seven of nitrate of soda; seven of calcined iron scales; seven of refined borax; seven of calcined copper; seven of oxide of manganese; and twenty parts of pulverized flint glass, are melted together in a large crucible or pot, in a glass furnace. When these ingredients have become fused, and the whole, or nearly the whole, of the volatile gas has been disengaged, the fluid mass is transferred to smaller pots for the convenience of casting. A cast-iron mould, in parts, is provided, its internal diameter being that of the cylinder required, and furnished with an inner core or tube, through which a current of cold water is continually flowing to prevent the fusion of the tube. When the melted glass is poured into the mould, a solid cylindrical piston is forced down upon it by a strong vertical screw, in order to compress and solidify the mass. The cylinder thus formed, is to be annealed in a kiln of the usual kind, by being placed in a case of iron rather larger than the cylinder itself, and surrounded with finely-powdered charcoal; this case is to be suspended within the kiln, so that the cylinder may be uniformly annealed all over. Or, the cylinder may be annealed in the mould in which it was cast. The cylinder is then to be smoothed and polished in the manner usually adopted in glass polishing.

Cylinders, plates, &c., may also be made of other materials, and coated externally with some suitable vitrified substance, capable of being acted upon in like manner by the acid. The cylinder, &c., produced in either of these modes, may be engraved upon the surface in the usual way of engraving glass, or may be etched by treatment with the acid; in the latter case, the parts not to be acted upon are protected by wax or other suitable etching grounds, and the cylinder immersed in hydro-fluoric acid; by this means the pattern, in relief for printing, or sunk if for embossing, is produced upon the surface, and the cylinder being mounted on a mandril or axis, is ready for use. In the formation of metal cylinders upon the plan here patented, tubes or linings of iron, or compressed wood, are put into cylin-

ders of brass, copper, or other suitable metals, thereby reducing the quantity of the more expensive materials. The external brass or copper cylinder has a lining cemented throughout its length, furnished at each end with a screw projecting beyond the cylinder for receiving two caps or nuts, which attach it securely to the cylinder. A rib or feather upon the lining tube fits into a corresponding groove upon the axis or mandril, in the usual way of mounting printing cylinders.

Mech. Mag., Nov., 1840.

Specification of a patent granted to Henry Montague Grover, *of Boveney, Buckingham, for an improved method of retarding and stopping Railway Trains.* [Enrolled, Nov. 2, 1840.]

The "method" here patented, if not an improved, is at least an abundantly "singular" one. From the lower frame of the carriage or truck, a wooden block or box is suspended by a bar link, within about half an inch, more or less, of the wheel; this box contains a large soft iron horse-shoe, enveloped with wire helices for converting into a powerful electro-magnet when its good offices are required. From these helices, wires proceed up into the carriage where a galvanic battery is situated, and with which they can be connected at pleasure. Should any accident or other circumstance render it expedient to retard or stop the train, connecting the wires with the battery converts the horse-shoe into a powerful magnet, which, hanging within a "striking distance," catches hold of the rim of the iron wheel, pressing itself and the wooden box against it, after the manner of the brakes usually employed. The patentee states that these electro-magnetic brakes may be applied to one or more of the wheels of a train, or the apparatus may be applied to one wheel, and its action transmitted to other wheels by means of levers. We apprehend Mr. Green has greatly underrated the extent of power required to arrest the progress of railway trains, and the electro-magnetic power capable of being obtained by the means he proposes. Ibid.

Specification of a patent granted to Thomas Gadd Matthews, *and* Robert Leonard, *of Bristol, for certain improvements in machinery or apparatus for Sawing, Rasping, or dividing Dye Woods or Tanners' Bark.* [Enrolled, Nov. 5, 1840.]

These improvements consist in certain arrangements of circular saws, by means of which, woods, or bark, are reduced to a finely divided state for the use of dyers and tanners, in a more economical and expeditious manner than has heretofore been effected. The peculiar feature of this invention is, combining a number of circular saws upon a rotary spindle in such a manner that although not in actual contact, they are placed so nearly contiguous to each other, that when a piece of wood, or a quantity of bark is brought under their operation, it will be sawn, rasped, or reduced to a finely divided state without leaving any veneer. The circular saws are mounted

on their spindle, and the space between each saw is filled up with pieces of wood, felt, metal, pasteboard, or other suitable substance; the saws are then secured between two cheeks by nuts and screws. The log of wood is placed upon an inclined plane, and made to slide down towards the saw by a pushing apparatus, consisting of a worm wheel, rack and pinion, driven by suitable gearing connected with the prime mover of the machine. A counterbalance weight is attached to the rack by a cord passing over a pulley, to facilitate its ascent up the inclined plane, for the introduction of a fresh log of wood. The claim is to the application of rotary circular saws to the sawing, rasping, or reducing to powder, of woods or bark, for the use of dyers or tanners in whatever manner the same may be applied.

Ibid.

Specification of a patent granted to William Peirce, *of James's Place, Hoxton, for improvements in the construction of Locks and Keys.* [Enrolled, Nov. 2, 1840.]

These locks, which are upon Barron's principle, with numerous tumblers, are furnished with a detector, consisting of a sliding bolt acted upon by any one or all of the tumblers; the opposite end of this sliding bolt is jointed to a small lever, mounted on a suitable axis. Within a tube, opposite the lower part of the key-hole, a dart, or sharp-edged punch is placed upon a strong spiral spring; there is a notch on the under side of the dart, in which the detector lever rests and holds the dart down upon the compressed spring. On attempting to open the lock with any but the original key, one or other of the tumblers is over lifted, which, acting on the detector lever, releases the dart or punch which flies out through the key-hole, wounding the hand that holds the key. The face of the punch being in the form of a letter or figure, inflicts a wound that for several weeks identifies the aggressor; these locks have therefore been termed *Identifying Detector Locks.*

In order to prevent the accumulation of dirt, &c., within the pipe of the key, a metal stop is fitted so as to work freely within it, being kept flush with the end of the pipe by means of an internal spiral spring, which yields to the pin of the lock when in use.

The claim is,—1st. The mode of constructing detecting locks. 2nd. The mode of applying spring stops to keys.

Ibid.

Progress of Practical & Theoretical Mechanics & Chemistry.

Observations on Coal, the duration of its supply, and on its reproductive Power. By Dr. Wilkinson, *Bath.*

During the debates on the Budget for 1838, Sir R. Peel remarked on the proposed reduction of duty on coal, in order to promote its exportation, that he was not satisfied of the abundant supply of coal

in this country. He knew that the reproductive power of coal was not so rapid as the consumption, whatever chemical combinations it might possess. Any observations made by this distinguished statesman are entitled to the most respectful attention. I presume, the most satisfactory reply will be by an inquiry into the formation of coal, from which may be deduced the degree of apprehension as to the duration of its supply; and whether any such apprehension may be diminished by any supposed reproductive power.

In some "Observations" I lately published on the green mineral naptha of Barbadoes, I introduced some new opinions relative to coal. These opinions have led to correspondences with many of my philosophical friends; and the result has been, that probably coal does not originate from vegetable matter. In those extensive masses of vegetables discovered at considerable depths below the earth's surface, or the beds of the ocean with its sub-marine forests, elevated by the agency of volcanic power above its water level, the wood assumes different characters, according to the conditions to which it may be subsequently subjected. In the vicinity of Bath, I have seen, under the blue lias, the same mass of wood undergoing different changes; that part which had not been under much pressure retaining its ligneous character—the next portion resembling the surturbrand of Iceland, or the Bovey coal of Devonshire—and the extreme part had exactly the character of jet, admitting of such a beautiful polish, that the present ingenious engineer to the Kennet and Avon Canal Company (Mr. Eastwick) made from it a series of primitive crystals. In the heath where Bovey coal is found, are numerous stumps and roots of trees, so that the coal appears to be the broken trunks and branches, which, by slow and gradual change from the vegetable character, are converted to that of jet or asphaltum. These changes appear to have resulted from the combined effects of water and pressure, without any agency of heat, the bituminous matter being retained; vegetable matter exposed to the action of water alone, undergoes a gradual change, blackens, and assumes a charred appearance. It is by such a process, the roots and stalks of vegetables, on heaths and morasses, are converted into turf; when deeper in the earth, then a slight pressure operates, that the roots and fibres become less distinct, the vegetable is resolved into a black extractive substance, and called peat; and when extensive masses are immerged at greater depths, then surturbrand, Bovey coal, &c., are formed. All these substances, when analyzed, yield those results which correspond to the elementary constituent parts of vegetables.

With respect to coal, the formations are so distinct, that they are always found in the same relative geological situation. It is found in a basin reposing on limestone, and never observed either on primitive or transition rocks, and in the analysis yields very different results; frequently are observed vegetable impressions in the schist above coal, yet no geologist has inferred from this appearance that the substance originates from the same organic source. In those extensive analyses which are daily conducted on a large scale at gas establishments, five elementary principles are invariably found—viz.,

oxygen, hydrogen, carbon, nitrogen, and sulphur; and, with the carboniferous limestone, millstone grit, and old red sandstone, constitute a series of associated rock formations, and with regular alternations. This is not the case with turf, peat, Bovey coal, &c. They are invariably found to result from binary or ternary arrangements of the three elementary principles—viz., oxygen, hydrogen, and carbon—and which we invariably find resulting from the destructive distillation of wood. In no instance are found in these substances either nitrogen or sulphur, nor are they observed to have any regular geological position. Turf and peat are found on the granite beds of Greenland and Iceland, and on the tertiary beds of France and England. Hericart de Thury describes some of these deposits in Dauphiny at 7000 feet above the level of the sea. The celebrated botanist, De Candolle, observed, that in Holland the turf is the result of sea weeds, and, in elevated districts, principally from the leaves of trees. Most of these are of recent formation; wood which has been worked, and tools of iron, have been found in the turtiary.

It must be admitted, that in coal-fields are observed representations of the trunks and stems of arundinaceous plants, also some participating of the palmaceous and of coniferous plants; and my late learned friend, Steinhauer, supposed he had discovered tubular acini or leaves in some of the calamites and portions of the phitolithus notatus. In these I have never observed any satisfactory ligneous characters, nor is it easy to conceive that, in such extensive imaginary woody masses, the vegetable part should be so effectually removed, and in lieu thereof earthy materials substituted, excepting a very thin tunic of carbonized matter, which certainly increases the difficulty attending the hypothesis of the whole mass being a cast corresponding in size to the supposed vegetable. When coal appears in the vicinity of rocks of igneous origin, as the Rowley rag, basalt, &c., its bituminous portion is volatilized, and it exists in a coke-like form; so also, when not reposing on its limestone bed, but on the lower red sandstone, it equally loses its principle of inflammation, and constitutes stone coal or culm, as seen in Wales.

Contemplating coal as a distinct rock formation, formed under certain conditions of the earth long anterior to man, we have no more reason for supposing any reproductive power, than that those portions of St. Vincent's Rocks which have been detached may be again restored. Thus, considering coal as not a vegetable product, or consisting of such principles as not to admit of any supposed power of reproduction, have we any reason to apprehend a serious exhaustion of this valuable material?

Let us take into our calculation the extensive coal-fields of Northumberland and Durham, Yorkshire, Warwickshire, Lancashire, Shropshire, Staffordshire, Cumberland, Somersetshire, Gloucestershire, and the counties of Nottingham and Derby, and, when to these we add the great supply afforded by Scotland, North and South Wales, we need be under no apprehension that, however great our consumption, still our supply is not only adequate to every purpose, but also

would justify Government in promoting exportation by every effort in their power. **Min. Review, December, 1840.**

On the Manufacture of Flint Glass. By Apsley Pellate, A. C. E.

Flint glass, called by the French "crystal," from its resemblance to real crystal, is composed of silex (whence the English name,) to which is added carbonate of potash and litharge, or red lead; to which latter material is owing, not only its great specific gravity, but its superior lustre, its ductility, and power of refraction.

It is necessary for optical purposes that flint glass should be perfectly free from striæ, otherwise the rays of light passing through it diverge and become distorted, and this defect is caused by the want of homogenity in the melted mass, occasioned by the difficulty of perfectly fusing substances of such different density as the materials employed. The materials being properly prepared, are thrown at intervals into a crucible of Stourbridge clay, which will hold about 1600 lbs. weight of glass when fused. The mouth of the crucible is then covered with a double stopper, but not luted, to permit the escape of the moistute remaining in the materials, as well as the carbonic acid gas and excess of oxygen. It requires from fifty to sixty hours application of a rapid, intense, and equal heat to effect the perfect fusion of the materials, and to drive off the gas; during which time the unfused particles and excess of salts are skimmed off as they rise to the surface. The progress of fusion cannot be watched, nor can any mechanical means for blending the materials during fusion be resorted to, lest the intensity of the heat requisite for the production of a perfectly homogeneous glass should be diminished, the quality of the product being influenced by any inattention on the part of the fireman, as well as by the state of the atmosphere, or of the wind. It has been ascertained, that there is a certain point, or crisis, of fusion at which the melted metal must be kept to insure a glass fit for optical purposes, and even when that point be attained, and the crucible shall furnish proper glass during several hours, should there be such diminution of heat as to require the furnace to be closed, the remainder of the metal in the crucible becomes curdy and full of striæ, and thus unfit for use. It is the same with the glass made for the flat bore tubes for thermometers, which are never annealed, because the smoke of the annealing furnace would render the interior of the bore unfit for the reception of the mercury. These tubes will only bear the heat of the blow pipe when they are made from a metal which has been produced under all the favourable circumstances before described. It is, therefore, to be inferred, that the most homogeneous and perfect flint glass can only be produced by exposure to an intense and equable degree of heat, and that any excess or diminution of that heat is injurious to its quality.

Flint Plate.—The English method of manufacturing the flint plate for optical purposes is thus described. About seven pounds weight of the metal is taken in a ladle of a conical shape from the pot at the

proper point of fusion, and then blown into a hollow cylinder, cut open, and flattened into a sheet of glass of about fourteen inches by twenty, and varying in thickness from three-eighths to one-fourth of an inch. This plate is afterwards annealed, and in this state goes into the hands of the optician, who cuts and grinds it into the requisite form. When a glass furnace is about to be put out, whole pots of metal are sometimes suffered to remain in it, and cool gradually. The crucibles being destroyed, pieces of glass may be cloven from the mass of metal, softened by heat, and made to assume the requisite form, and then ground. It is believed that the excellent glasses made by Frauenhoffer, and other manufacturers on the continent, are produced by some such means. On attempting to cut glass ware, it is easily perceived if it be sufficiently annealed; if not, the ware is put into tepid water, which is heated, and kept at the boiling point during several hours; it is then suffered to become gradually cold. This method is more efficacious than re-annealing by the ordinary means. A piece of unannealed barometer tube of forty inches in length being heated and quickly cooled, contracted only one-sixteenth of an inch, whereas a similar piece, annealed by the usual means, contracted nearly one-eighth of an inch. Unannealed flint glass, being heated and suddenly cooled in water, exhibits the appearance of a mass of crystals; it is thence inferred that the process of annealing renders the glass more compact and solid; it thus becomes incapable of polarization.

Railway Mag., December, 1840.

New Air Engine.

Both in England and France many unsuccessful attempts have been made to convert air into a motive power—Sir George Cayley has at length succeeded. The public will have an opportunity of judging for themselves of the value of this discovery, as soon as a locomotive carriage, now in progress of manufacture, can be got ready. The principle of the new engine is easily explained—the details we reserve for another occasion. Air is compressed by the pump into a receiver, to be used when wanted. Motion is communicated to the wheels by pistons acted upon by the air, which is rarefied by heat in its passage from the receiver to the cylinders, where it acts upon the piston rod much in the same way that steam does. Thus, to communicate motion to the piston, a portion of the air in the receiver is forced by compression into tubes subjected to heat, and from thence, in its rarefied state, it rushes to the cylinders as the only place of escape. Motion is accordingly produced. An experimental engine, upon this plan, was exhibited last year to Messrs. Babbage, Rennie, Gordon, Bramah, Renton, and others. It worked with great steadiness at rather above five horse power. The power, which was under perfect control, was capable of immediate increase or decrease, the expense of fuel following exactly the same ratio as the power, which is one of the peculiarities of this engine. If it were stopped for a minute, or any number of minutes, or for half an hour, no loss of fuel took place—that is

to say, no loss takes place while the engine stands idle. No water is required—a serious consideration; and the consumption of coke is only from four to five pounds weight per horse power per mile.

This experimental engine, though perfect as to power, was found inconvenient, in consequence of some of the dust from the coke getting into the working cylinders, which caused them to require more lubrication than was convenient for practical purposes. The engine now building is constructed upon a plan to do away with this evil, which appears to be the only remaining impediment to be overcome. The air engine, by obviating the necessity of carrying water, and by obtaining the full power from combustion in the most economical manner, bids fair to be applicable on many occasions where the steam engine is inconvenient, and to vie with it in power. We are extremely anxious to see the new machine at work.

Mining Journal, December, 1840.

Progress of Civil Engineering.

Experiments with Locomotive Engines, on the Hull and Selby Railway.

On Tuesday, the 10th instant, a course of five days' experiments commenced with the engines of the above railway, originating through the following circumstances:—

About the commencement of the present year, six engines somewhat similar to those on the Leeds and Selby line, were in greater or less state of forwardness for the Hull and Selby Railway, at the works of Messrs. Fenton, Murry, and Jackson, of this town, when the Hull and Selby Railway Company resolved to have six other engines, on the most approved construction which experience up to that period could produce, from the previous working of locomotives on the various railways. Four objects were particularly kept in view, namely, *safety*, *simplicity*, *accessibility* of the various parts, and *economy*, the whole combining general *efficacy* and *durability* of the engine throughout.

The first object is secured by giving a more extented *base* for the action of the springs in supporting the weight of the engine, being about six and a half by eleven feet, whereby a remarkably steady motion is secured at thirty miles per hour. It is not at all a matter of surprise that the four wheeled engines of several railways now in use should now and then go off the road, and in an instant, when it is recollected the extreme base of their springs for supporting the engine is only about three and three-quarters by about six feet; hence their rocking, serpentine, and pitching motion, which without any other cause than a slight increase of speed, literally lifts the flanches of the wheels above the surface of the rails, and in three or four seconds the engine is turned end for end, upset in the act, and the train with it; whilst the stability of the engine is effectually secured through an extended base upon the front and hind wheels. By means of a new

combination the best properties of the four-wheeled engines are also completely applied, by resting the weight on the crank-shaft immediately within the wheels, which experience has for years proved to be the least likely to injure it, and thereby avoiding the alarming accidents which have so often taken place by the breaking of the shaft, through placing the weight on bearings outside of the wheels; the centre of the engine being a sort of neutral axis, there is very little power over its motion in that part, and this advantage, by placing the weight on the crank inside the wheels, is in consequence got without a sacrifice of stability.

2ndly. In addition to the safety and simplicity of having only *two* inner frames, instead of three or four, with as many bearings on the crank shaft, the space under the boiler is still further stripped of machinery by a new valve motion, which gives a high degree of openness and facility of access so desirable in examination, cleaning, &c., of the working parts.

3rdly. The steam being used expansively by the valve motion above alluded to, a great saving in fuel is effected, as will be seen on examining the results of the experiments; and as the excessive wear and tear of locomotive boilers arise from intense heat, it is not improbable this decided step towards removing the cause will prevent the effect, namely, the rapid destruction of the boiler. The action of this valve motion is perfectly smooth, being worked by eccentrics (which are also of an improved construction,) and any quantity of steam from 25 to 90 per cent. on the stroke can be admitted into the cylinders with the most ready and complete control, at any speed the engine may be going; if a high wind, or an incline, opposes the progress of the engine, a greater quantity of steam is admitted; if wind or gradients be favourable, the steam is still admitted at full pressure into the cylinders, but shut off at an earlier period, propelling the pistons the remainder of the stroke by its elastic force, similar to driving a timepiece by the uncoiling of the main-spring.

Lastly. A combination of dimensions and proportions have been gleaned from the best results of locomotive engines of various constructions, and in use in different parts of the country. The driving wheels are six feet diameter, length of the stroke two feet, diameter of cylinders twelve inches, inside dimensions of fire box three by three and a half feet, tubes ninety-four in number by nine and a half feet long and two inches diameter. The general diminution of machinery in the construction has given room for ample dimensions in the principal working parts, and thus the whole arrangement has a close bearing on *safety, simplicity, accessibility, and economy.*

Circumstances led to those engines being ordered of Messrs. Shepherd and Todd, Railway Foundry, of this town. The Hull and Selby line was opened with the engines of the former order, but the public and the Company being so much annoyed by hot cinders from their chimneys, burning whatever they lighted upon, and rapidly destroying the smoke-boxes themselves, three of those engines were altered, and succeeded to a considerable extent in diminishing the nuisance, whilst the engines performed better and with less fuel. That fact,

however, being questioned, and two engines of the *improved* construction having got to work, Mr. John Gray, the engineer of the locomotive department, and patentee of the improved engines, urgently requested a most rigorous and simultaneous trial of the different engines, and to be witnessed for the parties concerned by persons above suspicion. Mr. J. Miller and Mr. T. Lindsley represented Messrs. Fenton, Murray, and Jackson; Mr. J. Craven and Mr. J. Barrons represented Messrs. Shepherd and Todd; and Messrs. E. Fletcher, W. B. Bray, J. G. Lynde, jun., J. Farnell, and J. Gray, were the representatives of the Hull and Selby Railway Company. The arrangements for the experiments were, that the gross load should include engine, tender, carriages, and everything in the train.

The steam was got up in the respective engines to the pressure of from fifty-six to sixty-six pounds per square inch; the fires filled to a certain level at the starting in the morning, and filled to the same level on finishing the last trip at night. The pressure of steam at starting was generally up to sixty-six pounds, and was at about half that pressure at the end of each trip. There were *fifty* experimental trips made in all, namely, twenty-four trips with the *Collingwood*, *Andrew Marvel*, and *Wellington*, the unaltered engines of Messrs. Fenton, Murray, and Jackson. Their average gross load was 53.4 tons, or 1,656 tons, over one mile: consumption of coke 1,013 lbs., or 0.611 lbs. per ton per mile; water 6,500 lbs., or 3.90 lbs. per ton per mile. There were ten trips made with the other three engines of Messrs. Fenton, Murray, and Jackson, which were altered at Hull, namely, the *Exley*, *Kingston*, and *Selby*. Their average load was 49.16 tons, or 1,524 tons over one mile; consumption of coke 635 lbs., or 0.416 lbs. per ton per mile; water 4,264 lbs., or 2.79 lbs. per ton per mile.

The *patent* engines made by Messrs. Shephard and Todd, viz. the *Star* and *Vesta*, made sixteen trips, and their average loads, &c., were 55.4 tons, or 1,718 tons over one mile; coke consumed, 465 lbs., or 0.271 lbs. per ton per mile; water 2,874 gals., or 1.62 lbs. per ton per mile. The average gross load of all the fifty trips is 53.2 tons, or 1,649.4 tons over one mile, and taking that as a standard load, the consumption of fuel and water performing exactly equal quantities of work, is represented in the following table:

Class of engines.	Load in tons conveyed over one mile.	Elsecar coke used per trip of 31 miles in lbs.	Coke used per mile in lbs.	Coke used per ton per mile in lbs.	Water used per trip of 31 miles in lbs.	Water per mile in lbs.	Water per ton per mile in lbs.
Patent . .	1649.4	446.98	14.41	0.271	2672	86.19	1.62
Altered . .	1649.4	686.15	22.13	0.416	4601.8	148.43	2.79
Unaltered .	1649.4	1007.78	32.59	0.611	6432.6	207.5	3.90

The financial annual result of the three classes of engines for coke

and boilers, with such a traffic as that of the Hull and Selby line, will be about—

4,500*l.* for the unaltered engines,
3,250*l.* for the altered do.; and about
2,000*l.* for the patent engines.

In conclusion, it is deserving of remark, that *all* the attesting witnesses expressed themselves highly satisfied with the manner in which the experiments had been conducted, and with the facilities which the Company so readily granted to enable them to come at correct results. Probably no experiments were ever made under similar circumstances where the parties concerned displayed greater independence, impartiality, and good feeling, than on the present occasion.—*Leeds Mercury.* Mech. Mag., November, 1840.

An Account of the actual State of the Works at the Thames Tunnel (June 23, 1840.) *By* M. I. Brunel, M. Inst. C. E.

In consequence of local opposition, the works have not advanced much since the month of March, 1840; but, as that has been overcome, and facilities granted by the city, the works will be speedily resumed, and the shaft on the north bank commenced.

The progress of the Tunnel in the last year has been, within one foot, equal to that made in the three preceding years. During those periods collectively, the extent of the Tunnel excavated was 250 feet 6 inches, and during the last year the excavation has been 249 feet 6 inches. This progress has been made in spite of the difficulties caused by the frequent depressions of the bed of the river. These have been so extensive that in the course of twenty-eight lineal feet of Tunnel, the quantity of ground thrown upon the bed of the river, to make up for the displacement, in the deepest part of the stream, has been *ten times* that of the excavation, although the space of the excavation itself is completely replaced by the brick structure. On one occasion the ground subsided, in the course of a few minutes, to the extent of thirteen feet in depth over an area of thirty feet in diameter, without causing any increased influx of water to the works of the Tunnel. The results now recorded confirm Mr. Brunel in his opinion of the efficiency of his original plan, which is "to press equally against the ground all over the area of the face, whatever may be the nature of the ground through which the excavation is being carried." The sides and top are naturally protected; but the face depends wholly for support upon the poling boards and screws. The displacement of one board by the pressure of the ground might be attended with disasterous consequences; no deviation, therefore, from the safe plan should be permitted.

The paper is accompanied by a plan, showing the progress made at different periods. It is stated that a full and complete record of all the occurrences which have taken place during the progress has been kept, so as to supply information to enable others to avert many of the difficulties encountered by Mr. Brunel in this bold yet successful undertaking. Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, MAY, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
3	6	12	Im. 75 Virginis,	6	16°	330°
3	7	1	Em.		275	234
7	16	26	Im. *y* Ophiuchi,	6	60	86
7	17	32	Em.		315	352
10	16	17	Im. 351 Sagittarii,	6	133	129
10	17	42	Em.		278	293
23	7	43	Im. *m* Geminorum,	6	79	136
23	8	37	Em.		232	286
25	9	28	Im. 82 Cancri,	6	79	132
25	10	20	Em.		220	273
25	9	33	Im. π^2 Cancri,	6	94	147
25	10	20	Em.		210	280

Meteorological Observations for February, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	32	30	29.80	29.60	E.	Moderate.	.67	Cloudy—rain and sleet.
	2	29	36	.70	.75	W.N.W.	do.		Partially cloudy—par. cloudy.
	3	34	38	.60	.50	W.	do.		Partially cloudy—par. cloudy.
	4	24	32	30.14	30.15	W.	do.		Clear—clear.
☺	5	22	38	.03	29.92	N.E.	Calm.		Clear—clear.
	6	31	43	29.84	.86	N.E.N.	do.		Lightly cloudy—cloudy.
	7	33	32	.88	99	N.	Moderate.		Partially cloudy—snow.
	8	24	35	30.14	30.18	W.	Calm.		Clear—partially cloudy.
	9	30	33	.00	29.83	N.E.	do.	.30	Cloudy—snow.
	10	19	31	29.73	.72	N.	do.		Clear—flurry of snow—clear.
	11	8	16	.89	.84	W.	Moderate.		Clear—clear.
	12	3	12	.88	.84	W.	do.		Clear—flying clouds.
☽	13	7	17	.79	.78	W.	Brisk.		Clear—clear.
	14	13	27	.77	.77	W.	Moderate.		Fleecy clouds—hazy.
	15	13	22	.72	81	N.W.	blustering.		Clear—hazy.
	16	16	33	.90	.85	W.	Moderate.		Clear—do
	17	27	37	.60	.60	E.	do.		Cloudy—lightly cloudy.
	18	21	31	.95	.93	N.	do.		Cloudy—cloudy.
	19	28	37	.60	.55	W.	do.		Clear—cloudy.
	20	23	39	.70	.63	W.	blustering.		Clear—clear.
⊗	21	29	50	.50	.49	W.	Moderate.		Clear—cloudy.
	22	24	41	.50	.50	S.W.	do.		Cloudy—hazy.
	23	35	45	.35	.35	E.W.	Brisk.		Clear—cloudy.
	24	21	25	30.05	30.05	W.	Moderate.		Cloudy—snow.
	25	18	33	.10	.10	E.	do.		Clear—lightly cloudy.
	26	32	47	.00	.10	W.	do.		Cloudy—clear.
	27	40	41	29.60	2 60	E.	do.	.15	Cloudy—rain.
☾	28	32	50	.85	.86	S.W.	do.		Clear—clear.
	Mean	23 97	34.07	29.81	29.79			1.12	

	Thermometer.		Barometer.	
Maximum height during the month,	50 00	on the 21st and 28th.	30.18	on the 8th.
Minimum " "	3 00	on the 12th.	29.35	" 23rd.
Mean	29.02		29.80	

							Hygrometer.					
	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
	3⅓	⅓	8	1	.	3⅓	....	.	....	....	.	1289
1												
2	⅓	⅔	14	⅓	.	⅔	....	.	.....	....	.	1277
3												
4	3	.	9⅓	.	.	5	....	.	....	....	.	1238
5												
6												
7												
8	[illegible]⅓	⅔	8⅓	.	.	.	....	.	.....	....	.	1233
9												
10	[illegible]⅔	⅔	2	⅓	8⅓	.	....	.	.....	....	.	1279
11	[illegible]	.	19⅓	.	.	.	....	.	......	....	.	1240
12	[illegible]	.	8	.	.	.	....	.	......	....	.	1312
13												
14	⅔	1	5	4⅔	.	1⅔	55.11	3	.....	61.72	3	1245
15												
16												
17	⅔	.	10⅔	.	.	3⅔	....	.	......	....	.	1217
18	[illegible]	⅓	5⅓	.	2⅓	⅓	....	.	.....	62.48	1	1243
19												
20												
21												
22												
23												
24												
25	[illegible]	.	4⅔	.	14⅓	4	....	.	.....	....	.	1231
26												
27												
28	[illegible]	⅓	5	⅓	5	⅓	....	.	.....	....	.	1280
29												
30	2⅓	.	.	.	.	2	....	.	.....	....	.	1235
31	2⅔	.	3	⅓	3⅓	13⅔	....	.	.....	....	.	1236
32												
33	2⅓	.	3	.	.	5½	....	.	.....	64.07	2	1234
34												
35	2	⅓	7⅔	⅔	3	2⅓	....	.	.....	....	.	1237
36	2⅔	8	6	1	.	1	....	.	.. .	....	.	1242
37	2⅔	1⅓	2	.	11⅔	1⅓	....	.	.....	....	.	1246
38	2⅓	.	3⅓	.	11⅔	.	....	.	...	....	.	1304
39												
40	2	.	2⅔	⅔	13⅓	6	....	.	....	....	.	1230
41	2	.	19⅓	.	.	1	....	.	.....	....	.	1232
42												
43												
44	3⅔	.	7	.	6⅓	.	....	.	.....	....	.	1271
45												
46												
47	2	⅓	1⅓	.	11	6	....	.	......	....	.	1244
48	2⅓	⅔	9	⅓	5⅔	1⅓	....	.	......	....	.	1376
49	2	.	3	.	.	.	....	.	.....	....	.	1239
50												
51	2⅓	⅓	8⅔	.	2⅓	3	....	.	.....	....	.	1241
52												
53												

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
SEPTEMBER, 1840.

Thermometer.

County.	Town.	Observer.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.
1 Philadelphia,	Philadelphia,	J. M. Hamilton,	61.32	66.80	59.46	79.00	49.00	62.53	1⅓	40.00	57.47	1
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	56.80	68.50	54.08	80.50	32.00	59.79	⅓	32.00	46.23	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,	55.43	68.39	59.10	76.00	45.00	60.97	1⅓	....	....	.
6 Monroe	Stroudsburg,	A. M. Stokes,										
7 Pike,	Milford,	Ralph Bull,										
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,	52.10	64.97	55.97	77.00	36.00	57.68	.	35.00	47.70	.
10 Luzerne,	Wilkesbarre,	W. F. Dennis,										
11 Schuylkill,	Port Carbon	P. C. Lyceum,	50.27	70.37	53.43	83.00	36.50	58.02	.	33.00	46.05	.
12 Berks,	Reading,	C. F. Egelmann,	56.50	66.00	55.37	78.00	43.00	59.29	.	...	...	.
13 Chester,	West Chester,	Wm. W. Jefferies,	56.50	69.13	65.83	81.00	39.50	63.82	.	36.00	51.64	.
14 Delaware,	Haverford,	Haverford School,										
15 Lancaster,	Lancaster,	Conservatory of Arts,	55.19	71.52	58.33	82.50	41.50	61.68	1⅓	38.50	51.78	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	58.11	67.54	63.69	76.00	44.00	63.11	3⅔	46.00	56.72	5
19 Northumberland,	Northumberland,	Andrew C. Huston,	58.55	65.52	58.98	75.00	41.00	60.05	⅓	33.00	45.53	.
20 Columbia,	Danville,	C. H. Frick,										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Rinkead,	48.34	72.50	54.42	83.50	33.00	58.42	3⅓	....	....	.
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,										
29 Adams,	Gettysburg,	Prof. M. Jacobs,	53.58	69.21	57.79	81.00	36.50	60.19	.	34.00	49.20	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	53.37	70.17	56.93	82.00	36.00	60.16	2	....	....	.
32 Centre,	Bellefonte,	John Harris,	46.75	68.89	55.12	79.00	31.50	56.92	10	....	....	.
33 Potter,												
34 M'Kean,	Smithport,	Richard Chadwick,	46.93	66.55	50.29	78.00	32.00	54.59	1	25.00	42.43	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	47.38	65.92	50.70	77.00	33.00	54.67	2⅓	30.00	41.14	1
37 Bedford,	Bedford,	Samuel Brown,	54.32	69.71	60.59	80.00	36.00	61.54	1	....	....	.
38 Somerset,	Somerset,	George Mowry,	48.05	61.82	51.55	72.50	34.00	53.81	1⅓	31.00	43.97	2
39 Indiana,	Indiana,	Richard White,	58.93	64.50	54.40	75.00	40.00	59.28	.	....	....	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	C. S. Brown,	55.50	62.17	60.08	73.00	45.00	59.25	6	45.00	54.71	6
42 Venango,	Franklin,	Wm. Connely,	46.33	70.33	55.90	84.00	32.00	57.52	.	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weithers,	52.90	69.27	55.65	80.50	28.50	59.27	.	....	....	.
46 Green,												
47 Washington,	Cannonsburg,	A. H. Campbell,										
48 Allegheny,	Pittsburgh,	J. P. Bakewell,	59.44	68.44	62.62	78.00	46.00	63.50	5⅓	....	....	.
49 Beaver,	Beaver,	Wm. Allison,	53.40	69.52	55.97	86.00	36.00	59.63	1	....	....	.
50 Butler,	Butler,	Jacob Mechling,	52.60	66.57	59.63	77.00	40.00	59.60	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	J. Limber,	57.11	68.27	58.04	84.00	45.00	61.14	3⅔	40.00	49.64	8
53 Erie,	Erie,	Park & Reid,										

Barometer. / **Weather.**

County.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	30.18	30.12	30.15	30.39	29.71	30.15	⅓	25	6	.	9	....	....	..	2.100
3 Bucks,	30.06	30.04	30.04	30.30	29.60	30.04	⅓	17	10⅓	2⅓	9	....	....	..	3.122
5 Northampton,	30.01	29.98	29.99	30.30	29.70	29.99	7	.	.	.	....	....	....	..	.....
9 Susquehanna,	28.14	28.16	28.17	28.34	27.60	28.16	.	13⅔	16⅓	.	7	....	....	..	2.180
11 Schuylkill,	29.38	29.41	29.42	29.63	28.88	28.40	.	15⅔	14⅓	.	6	....	....	..	1.492
12 Berks,	29.92	29.94	29.91	30.16	29.44	29.92	.	16⅓	13⅔	.	8	....	....	..	1.487
13 Chester,	30.39	30.39	30.38	30.62	30.08	30.39	.	.	.	.	8	...	....	..	......
15 Lancaster,	29.55	29.56	29.54	29.81	29.06	29.55	1⅔	19⅓	9	1⅔	7	....	....	..	1.830
18 Dauphin,	29.81	29.78	29.77	30.03	29.40	29.79	3⅔	.	.	.	5	.. ..	....	1	1.534
19 Northumberland,	29.53	29.51	29.50	29.78	29.11	29.51	⅓	10⅓	19⅓	⅓	10	....	....	..	1.278
26 Juniata,	29.56	29.53	29.54	29.81	29.13	29.54	3⅔	13	12⅔	4⅓	....	....	....	..	......
29 Adams,	29.46	29.43	29.44	29.70	29.01	29.45	.	20⅓	9⅔	.	7	....	....	..	1.543
31 Huntingdon,	29.42	29.39	29.41	29.69	28.99	29.41	2	.	.	.	7	....	....	..	1.354
32 Centre,	29.35	29.34	29.35	29.60	29.09	29.35	11⅓	11	8⅔	10⅓	....	....	....	..	2.468
34 M'Kean,	28.15	28.22	28.12	28.40	27.80	28.16	1⅓	10	18⅔	1⅓	8	....	....	..	2.925
36 Cambria,	27.93	27.96	27.95	28.24	27.60	27.95	2⅓	12	13⅔	4⅓	10	....	....	..	2.525
37 Bedford,	29.32	29.31	29.27	29.59	28.90	29.30	1	17	12	1	....	....	....	..	......
38 Somerset,	28.04	28.04	28.04	28.29	27.66	28.04	1⅓	13	13⅔	1⅓	5	...	....	..	1.545
39 Indiana,	28.71	28.70	28.70	29.00	28.30	28.70	.	19	11	.	10	....	....	..	2.670
41 Warren,	28.88	28.87	28.86	29.14	28.41	28.87	6	17	7	6	....	....	...	..	......
42 Venango,	29.08	29.12	29.11	29.70	28.60	29.10	.	17⅔	11⅔	⅔	6	....	....	..	1.335
45 Fayette,	29.05	29.08	29.06	29.38	28.71	29.06	.	24⅔	5⅓	.	....	....	....	..	......
48 Allegheny,	29.36	29.32	29.33	29.68	28.92	29.34	5⅓	9⅔	15	5⅓	6	....	....	..	2.204
49 Beaver,	29.50	29.48	29.48	29.80	29.06	29.49	1⅓	17	11⅔	1½	....	....	....	..	......
50 Butler,	28.91	28.91	28.91	29.20	28.60	28.91	.	.	.	.	7	...	....	..	3.545
52 Crawford,	28.86	28.84	28.85	29.08	28.42	28.85	3	13	14	3	9	....	....	..	3.891

Winds. / **Hygrometer.**

County.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	3	.	1⅓	.	1⅓	⅓	.	⅓	3⅔	1⅓	3⅓	⅓	3⅓	⅓	8	1	.	3⅓	....	.	....	....	.	1289
3 Bucks,	2	1⅓	1⅓	.	.	.	.	⅔	⅓	1	7	.	⅓	⅔	14	⅓	.	⅔	....	.	.....	....	.	1277
5 Northampton,	1	.	1⅔	.	⅓	.	⅔	.	1	.	8	.	3	.	9⅓	.	.	5	....	.	.. ..	....	.	1238
9 Susquehanna,	⅓	.	.	.	⅔	.	⅔	.	3	.	5⅔	⅓	10⅓	⅔	8⅓	.	.	.	....	.	.....	....	.	1233
11 Schuylkill,	1⅓	.	1	.	3	⅓	2	.	2⅔	.	4	1⅓	2⅔	⅔	2	⅓	8⅓	.	....	.	.....	....	.	1279
12 Berks,	1	.	1	.	.	.	⅔	.	⅓	.	5⅔	.	2	.	19⅓	.	.	.	....	.	......	....	.	1240
13 Chester,	5⅔	.	⅔	.	2	.	1⅓	.	4⅓	.	3	.	5	.	8	.	.	.	....	.	......	....	.	1312
15 Lancaster,	3⅔	⅓	.	⅔	⅓	.	1	.	5⅔	⅓	5	.	⅔	1	5	4⅔	.	1⅔	55.11	3	.....	61.72	3	1245
18 Dauphin,	3⅔	.	⅔	.	⅔	.	1⅓	.	3⅔	.	2	.	3⅔	.	10⅔	.	.	3⅔	....	.	......	....	.	1217
19 Northumberland,	3	.	3⅓	.	1⅔	.	4	.	4⅓	.	1	⅓	4	⅓	5⅓	.	2⅓	⅓	....	.	.....	62.48	1	1243
26 Juniata,	.	.	⅓	.	⅓	.	1⅔	.	.	.	3⅔	.	1	.	4⅔	.	14⅓	4	....	.	.....	....	.	1231
29 Adams,	5	.	1	.	.	.	1	⅔	2	2	4⅓	1	2	⅓	5	⅓	5	⅓	....	.	.....	....	.	1280
31 Huntingdon,	.	.	.	.	6⅔	.	.	.	.	.	.	.	21⅓	.	.	.	.	2	....	.	.....	....	.	1235
32 Centre,	2	.	1⅓	.	.	.	.	.	.	⅔	1⅔	⅓	3⅔	.	3	⅓	3⅓	13⅔	....	.	.....	....	.	1236
34 M'Kean,	.	.	.	.	4	.	2	.	.	.	3⅓	.	12⅓	.	3	.	.	5½	....	.	.....	64.07	2	1234
36 Cambria,	1⅔	.	.	.	.	.	⅔	.	2⅓	.	4⅓	1	6	⅓	7⅔	⅔	3	2⅓	....	.	.....	...	.	1237
37 Bedford,	.	⅓	.	.	.	.	2⅓	2	.	.	5⅔	3	⅔	8	6	1	.	1	....	.	.. .	....	.	1242
38 Somerset,	1	.	.	.	.	.	1⅓	.	.	.	6	⅔	4⅔	1⅓	2	.	11⅔	1⅓	....	.	.....	....	.	1246
39 Indiana,	.	.	.	.	⅓	⅔	2	.	.	.	5⅔	.	6⅓	.	3⅓	.	11⅔	.	....	.	...	....	.	1304
41 Warren,	⅓	.	⅔	.	.	.	1	.	⅓	⅔	4⅓	.	.	.	2⅔	⅔	13⅓	6	....	.	....	....	.	1230
42 Venango,	.	.	.	.	.	.	4⅓	.	.	.	5	.	⅓	.	19⅓	.	.	1	....	.	.....	....	.	1232
45 Fayette,	⅓	.	1⅓	.	.	.	.	.	⅔	.	7⅔	.	6⅔	.	7	.	6⅓	.	....	.	.....	....	.	1271
48 Allegheny,	⅓	.	.	.	1	.	3	.	⅓	.	1⅔	.	5	⅓	1⅓	.	11	6	....	.	......	....	.	1244
49 Beaver,	.	.	1⅔	⅓	1⅔	.	4	.	.	.	4	.	1⅓	⅔	9	⅓	5⅔	1⅓	....	.	......	....	.	1376
50 Butler,	.	.	⅓	.	6⅓	.	1⅔	.	⅔	.	5	.	13	.	3	.	.	.	....	.	.....	....	.	1239
52 Crawford,	2	.	.	.	⅔	.	.	.	6⅓	.	3⅓	.	3⅓	⅓	8⅔	.	2⅓	3	....	.	.....	....	.	1241

	M Baro										Hygrometer.					
Collat olog vani		9, P. M.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Phil	30.12	3 5⅔	.	1⅔	⅓	5⅓	.	.	7⅓	....	.	....	....	.	1291
2	Mor															
3	Buc	30.02	3 5⅔	.	⅓	1⅓	10	⅓	.	1⅓	....	.	.....	....	.	1278
4	Lehi															
5	Nor															
6	Mon															
7	Pike															
8	Way															
9	Susq	28.04	2 ⅔	.	7	.	9⅓	.	.	.	....	.	.....	....	.	1330
10	Luze															
11	Schu	29.40	2 ⅔	.	5	⅓	2⅔	⅔	8	.	....	.	.....	....	.	1280
12	Berk	29.90	3 ⅓	⅓	1⅔	.	18	.	⅓	.	....	.	......	....	.	1256
13	Ches															
14	Dela															
15	Lanc	29.52	2	1⅔	1⅓	1⅓	4⅔	1⅓	.	⅔	52.38	2	.....	56.93	2	1262
16	York															
17	Leba															
18	Daup	29.76	3 ⅔	.	3	.	12⅓	.	.	1⅓	....	.	......	....	.	1251
19	North	29.48	2 ⅓	.	5⅓	.	2⅓	⅓	.	2⅔	....	.	......	56.29	.	1252
20	Colu															
21	Brad															
22	Tiog															
23	Lyco															
24	Unio															
25	Miffli															
26	Junia	29.52	2 ⅔	.	2⅓	.	5⅔	.	13⅔	2	....	.	.....	....	.	1255
27	Perry															
28	Cumb															
29	Adam	29.43	2 ⅓	⅓	1⅓	1	6⅔	.	.	.	....	.	.....	....	.	1282
30	Frank															
31	Hunt	29.36	29	.	18	.	.	.	.	⅔	....	.	.....	....	.	1275
32	Centr	29.26	29	⅓	5⅓	.	3⅓	.	2⅔	15⅔	....	.	.....	....	.	1260
33	Potter															
34	M'Ke	28.09	28	⅓	14	.	3	.	.	4	....	.	.....	63.50	18	1300
35	Clearf															
36	Camb	27.88	28	2	7⅔	.	6⅓	.	1⅓	4	....	.	.....	....	.	1261
37	Bedfo	29.26	29	⅓	5	.	2⅔	8	.	.	....	.	.. .	....	.	1254
38	Some	27.95	28	4	3⅓	⅔	3	.	7⅓	5⅔	....	.	.....	....	.	1253
39	Indian	28.62	28	.	8⅔	.	2	.	6⅔	6⅓	....	.	...	....	.	1305
40	Jeffers															
41	Warre															
42	Venan	29.14	29	.	.	.	16	.	.	⅓	....	.	.....	....	.	1257
43	Armst															
44	Westn															
45	Fayett	29.04	29	.	4	.	5⅔	.	4	.	....	.	.....	....	.	1272
46	Green,															
47	Washi	29.08	29	.	12⅓	.	2⅔	.	1	2⅓	....	.	......	....	.	1302
48	Allegh	29.30	29	1	6⅔	⅓	1⅔	.	10	⅓	....	.	......	....	.	1258
49	Beave	29.46	29	.	1⅓	.	13	⅔	5⅓	⅔	....	.	......	....	.	1377
50	Butler	28.83	29	.	12⅔	.	1	.	.	.	....	.	.....	....	.	1259
51	Merce															
52	Crawf	28.73	28	⅔	3	⅔	2	.	.	9	....	.	.....	....	.	1274
53	Erie,															

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

OCTOBER, 1840.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia,	Philadelphia,	J. M. Hamilton,	54.71	58.98	52.19	70.50	36.00	55.29	4 1/3	30.00	48.04	5
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	48.15	52.73	49.32	72.75	30.00	52.39	2/3	26.00	42.63	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,										
6 Monroe	Stroudsburg,	A. M. Stokes,										
7 Pike,	Milford,	Ralph Bull,										
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,	43.74	55.74	48.81	70.00	27.00	49.43	.	24.00	39.84	.
10 Luzerne,	Wilkesbarre,	W. F. Dennis,										
11 Schuylkill,	Port Carbon	P. C. Lyceum,	43.84	62.08	46.97	83.50	25.00	50.96	.	24.00	39.18	.
12 Berks,	Reading,	C. F. Egelmann,	48.45	57.48	50.29	74.00	27.00	52.07	.	...	...	.
13 Chester,	West Chester,	Wm. W. Jefferies,										
14 Delaware,	Haverford,	Haverford School,										
15 Lancaster,	Lancaster,	Conservatory of Arts,	49.35	62.53	52.50	81.00	29.00	54.79	2/3	27.00	45.92	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	50.65	56.83	51.89	71.00	32.00	53.12	2	30.00	47.90	2
19 Northumberland,	Northumberland,	Andrew C. Huston,	46.52	56.87	50.06	73.00	27.00	51.15	.	21.00	39.71	.
20 Columbia,	Danville,	C. H. Frick.										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Rinkead,	43.15	61.85	47.24	79.50	21.00	50.74	2 1/3	....	....	.
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,										
29 Adams,	Gettysburg,	Prof. M. Jacobs,	45.84	59.40	50.06	75.50	27.50	51.60	.	24.00	42.18	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	45.13	62.86	49.29	77.00	23.00	52.43	2/3	....	....	.
32 Centre,	Bellefonte,	John Harris,	41.98	59.46	46.66	71.50	18.00	49.37	10	....	....	.
33 Potter,												
34 M'Kean,	Smithport,	Richard Chadwick,	40.39	55.52	40.03	76.00	23.00	45.31	.	19.00	36.23	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	42.66	55.41	44.50	78.00	12.00	47.52	4	12.00	38.34	2
37 Bedford,	Bedford,	Samuel Brown,	46.04	61.12	50.59	81.50	24.00	52.58	.	....	....	.
38 Somerset,	Somerset,	George Mowry,	44.17	55.69	47.00	71.50	19.00	48.95	5	17.00	38.16	6
39 Indiana,	Indiana,	Richard White,	50.72	57.64	45.88	78.00	22.00	51.41	6 1/3	....	....	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	C. S. Brown,										
42 Venango,	Franklin,	Wm. Connely,	40.83	65.00	50.39	79.00	22.00	52.07	2	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weithers,	49.13	62.98	47.98	87.50	18.00	53.36	.	....	....	.
46 Green,												
47 Washington,	Cannonsburg,	Prof. A. H. Campbell,	32.81	47.03	35.90	64.00	14.00	38.58	.	14.00	28.70	.
48 Alleghany,	Pittsburgh,	J. P. Bakewell,	52.23	59.00	53.08	75.00	29.00	54.77	.	....	....	.
49 Beaver,	Beaver,	James Allison,	46.29	64.18	48.97	81.00	22.00	53.14	1	....	....	.
50 Butler,	Butler,	Jacob Mechling,	47.42	59.87	53.19	82.00	24.00	53.49	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	J. Limber,	55.37	58.28	46.47	81.00	28.00	53.37	1 1/3	18.00	33.66	2
53 Erie,	Erie,	Park & Reid,										

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	30.12	30.09	30.12	30.41	29.60	30.11	5 1/3	15	10 1/3	5 2/3	8	....	....	..	6.900
3 Bucks,	30.04	30.02	30.02	30.31	29.57	30.02	2/3	15 1/3	13	2 2/3	15	....	....	..	6.202
9 Susquehanna,	28.09	28.15	28.04	28.50	27.70	28.09	.	10	21	.	6	2	....	..	2.980
11 Schuylkill,	29.39	29.35	29.40	29.61	28.93	29.38	.	15 1/3	15 2/3	.	11	2	....	..	5.688
12 Berks,	29.89	29.87	29.90	30.16	29.44	29.89	.	14 2/3	16 1/3	.	9	....	....	..	3.676
15 Lancaster,	29.53	29.49	29.52	29.78	29.01	29.51	2/3	16 1/3	14	2/3	9	....	....	..	4.595
18 Dauphin,	29.78	29.74	29.76	30.03	29.32	29.76	2	.	.	.	9	1	....	..	4.227
19 Northumberland,	29.49	29.47	29.48	29.73	29.01	29.48	.	12 2/3	18 1/3	.	12	1	....	1	3.960
26 Juniata,	29.53	29.49	29.52	29.80	29.04	29.51	2	15	13 2/3	2 1/3	5	1	....	..	......
29 Adams,	29.44	29.43	29.43	29.68	29.87	29.43	.	17	14	.	12	....	....	..	7.118
31 Huntingdon,	29.38	29.35	29.36	29.59	28.92	29.36	2/3	18	12	.	8	1	....	..	3.395
32 Centre,	29.32	29.38	29.26	29.61	28.49	29.32	10	10 2/3	9 1/3	11	6	....	....	..	4.182
34 M'Kean,	28.08	28.10	28.09	28.25	27.80	28.09	.	11	20	.	10	3	....	..	3.578
36 Cambria,	27.89	27.88	27.88	28.10	27.51	27.88	4	10 1/3	15 1/3	5 1/3	10	1	....	..	3.636
37 Bedford,	29.26	29.24	29.26	29.45	28.80	29.25	.	16	15	.	....	....	....	..	......
38 Somerset,	27.95	27.94	27.95	28.14	27.60	27.95	5	11 1/3	14 2/3	5	8	2	....	..	2.972
39 Indiana,	28.64	28.62	28.62	28.90	28.30	28.62	6 1/3	12 1/3	12 1/3	6 1/3	....	....	....	..	......
42 Venango,	29.10	29.07	29.14	29.90	28.51	29.10	1/8	14 2/3	16	1/3	9	1	....	..	3.323
45 Fayette,	29.03	29.02	29.04	29.21	28.60	29.03	.	22 2/3	8 1/3	.	7	....	....	..	3.100
47 Washington,	29.06	29.02	29.08	29.35	28.54	29.05	.	10 1/3	15 2/3	5	6	1	...	..	2.970
48 Alleghany,	29.30	29.29	29.30	29.50	28.86	29.30	.	11 2/3	18	1/3	10	....	....	..	3.051
49 Beaver,	29.45	29.42	29.46	29.68	29.10	29.44	2/3	15	14 2/3	1 1/3	7	1	....	..	3.473
50 Butler,	28.84	28.83	28.83	29.00	28.50	28.83	.	.	.	.	10	...	....	..	3.877
52 Crawford,	28.74	28.71	28.73	28.96	28.40	28.73	1 1/3	15 1/3	14 1/3	1 1/3	14	1	....	..	6.153

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	1/3	.	1 2/3	.	2/3	1/3	2 2/3	.	4 1/3	2/3	5 2/3	.	1 2/3	1/3	5 1/3	.	.	7 1/3	....	.	....	....	.	1291
3 Bucks,	.	1/3	4	2/3	1	1	2 2/3	1/3	2/3	1/3	6 2/3	.	1/3	1 1/3	10	1/3	.	1 1/3	....	.	.....	....	.	1278
9 Susquehanna,	1 2/3	.	.	.	.	.	1 2/3	1 1/3	4 1/3	.	5 2/3	.	7	.	9 1/3	.	.	.	....	.	.....	....	.	1330
11 Schuylkill,	1/3	1/3	1 2/3	1/3	2 1/3	.	3 1/3	.	3 1/3	.	2 2/3	.	5	1/3	2 2/3	2/3	8	.	....	.	.....	....	.	1280
12 Berks,	.	.	2 2/3	.	1 1/3	.	2 1/3	.	1 1/3	2/3	2 1/3	1/3	1 2/3	.	18	.	1/3	.	....	.	......	....	.	1256
15 Lancaster,	3	1/3	1/3	.	2	1 1/3	4 2/3	2/3	2	2 1/3	3	1 2/3	1 1/3	1 1/3	4 2/3	1 1/3	.	2/3	52.38	2	.....	56.93	2	1262
18 Dauphin,	1/3	.	.	.	.	.	8 1/3	.	2	.	3 2/3	.	3	.	12 1/3	.	.	1 1/3	....	.	......	....	.	1251
19 Northumberland,	4 1/3	.	4	.	2 1/3	.	3 2/3	1/3	3 1/3	.	1/3	.	5 1/3	.	2 1/3	1/3	.	2 2/3	....	.	......	56.29	.	1252
26 Juniata,	1/3	.	1 1/3	.	2/3	.	3 1/3	.	.	.	1 2/3	.	2 1/3	.	5 2/3	.	13 2/3	2	....	.	.....	....	.	1255
29 Adams,	2 1/3	.	3	.	.	.	3 2/3	1	3 1/3	2	6 1/3	1/3	1 1/3	1	6 2/3	.	.	.	....	.	.....	....	.	1282
31 Huntingdon,	.	.	.	.	12 1/3	.	.	.	.	.	.	.	18	.	.	.	.	2/3	....	.	.....	....	.	1275
32 Centre,	1/3	1/3	.	.	.	.	.	.	1 2/3	1/3	1	1/3	5 1/3	.	3 1/3	.	2 2/3	15 2/3	....	.	.....	....	.	1260
34 M'Kean,	.	.	.	.	2 1/3	.	5 1/3	.	.	.	2	1/3	14	.	3	.	.	4	....	.	.....	63.50	18	1300
36 Cambria,	.	.	.	.	.	.	3 2/3	.	2 2/3	.	3 1/3	2	7 2/3	.	6 1/3	.	1 1/3	4	....	.	.....	....	.	1261
37 Bedford,	.	.	.	.	.	1	3	.	2	2 2/3	6 1/3	1/3	5	.	2 2/3	8	.	.	....	.	.. .	....	.	1254
38 Somerset,	1/3	.	.	.	1/3	.	1 2/3	.	2/3	.	4	4	3 1/3	2/3	3	.	7 1/3	5 2/3	....	.	.....	....	.	1253
39 Indiana,	.	.	.	.	1/3	.	1 1/3	.	2/3	.	5	.	8 2/3	.	2	.	6 2/3	6 1/3	....	.	...	....	.	1305
42 Venango,	.	.	1/3	.	.	.	7 1/3	.	.	.	7	.	.	.	16	.	.	1/3	....	.	.....	....	.	1257
45 Fayette,	1 1/3	.	2/3	.	.	.	1/3	.	4	.	11	.	4	.	5 2/3	.	4	.	....	.	.....	....	.	1272
47 Washington,	3 1/3	.	2 1/3	.	3	.	1 2/3	.	.	.	2 1/3	.	12 1/3	.	2 2/3	.	1	2 1/3	....	.	......	....	.	1302
48 Alleghany,	1/3	.	2/3	1/3	3	2/3	2 1/3	.	1/3	2/3	2 2/3	1	6 2/3	1/3	1 2/3	.	10	1/3	....	.	......	....	.	1258
49 Beaver,	.	.	1 1/3	.	1/3	.	3 2/3	1	.	.	3 2/3	.	1 1/3	.	13	2/3	5 1/3	2/3	....	.	......	....	.	1377
50 Butler,	1/3	.	3	.	5 2/3	.	1	.	1/3	.	7	.	12 2/3	.	1	.	.	.	....	.	.....	....	.	1259
52 Crawford,	2 1/3	.	.	.	1/3	.	1 1/3	1/3	5 2/3	1 1/3	4 1/3	2/3	3	2/3	2	.	.	9	....	.	.....	....	.	1274

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Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 224.]

7. *Comparison of the effects of high and low overshot wheels.*—The Committee next proceed to compare the deductions made for the overshot wheel No. I, with the results for Nos. II, III, and IV. The following table presents the ratio of effect to power in wheel No. II, fifteen feet in diameter.

TABLE EIGHTEENTH.

Showing the ratio of effect to power with overshot wheel No. II. Taken from table a. (Vol. ix, 2nd series, p. 298.)

Table.	Head above gate.	Head and fall.	Width of aperture.	Ratio of effect to power.	Mean ratio.	Table.	Head above gate.	Head and fall.	Width of aperture.	Ratio of effect to power.	Mean ratio.
	Feet.	Feet.	Feet.				Feet.	Feet.	Feet.		
a I.	5.50	20.50	1.00	.746	.746	a II.	1.50	16.50	1.75	.841	.840
"	3.00	18.00	1.00	.801		"	1.00	16.00	1.75	.855	.855
"	"	"	1.50	.818	.809	"	0.84	15.84	"	.830	.830
a II.	1.50	16.50	1.50	.840		"	0.75	15.75	"	.841	.841
				Mean	.777					Mean	.841

The average ratio with the low heads is the same as with wheel No. I. *Eighty-four per cent. of the power expended may, as before, be relied on for the effect.*

The falling off of the ratios at heads bearing a considerable proportion to the fall, is also distinctly seen, although the coefficients are not entirely regular in their increase.

We have now a satisfactory test to apply in ascertaining whether

the effect of an overshot wheel under different heads of water above the gate may be calculated by supposing the effect made up of the impulse from the water striking the buckets and of the gravity of the water in the subsequent descent.

As in the case before calculated, (pp. 323–4) the water is accelerated after leaving the aperture, and a virtual head corresponding to the distance from the bottom of the gate to the bottom of the bucket is to be found.* This, added to the head above the gate, is the head of impulse to which the undershot coefficient is to be applied.

The head above the bottom of the bucket, taken from the head and fall gives the height to which the theoretical overshot coefficient is to be applied. The sum of the products thus found, divided by the head and fall gives a coefficient which should correspond with the ratio actually found, if the principles and details of the calculation are correct.

The data are specified in the table which follows, with the particulars of the calculation. In the last two columns a comparison is made between the numbers thus calculated and the ratios actually found in the foregoing table.

TABLE NINETEENTH.

Comparison of the calculated with the observed ratios of effect to power, in overshot No. II.

Head above gate.	Effective head of impulse.	Product of effective head by undershot coefficient.	Product of fall, from bottom of bucket to bottom of wheel by overshot coefficient	Sum of product of effective fall by overshot coefficient and head by undershot.	Head and fall.	Calculated ratio of effect to power.	Ratio of effect to power by experiment.	Difference
Feet.	Feet.				Feet.			
5.50	7.12	2.02	12.73†	14.75	20.50	.720	.746	—.026
3.00	4.62	1.31	"	14.04	18.00	.780	.809	—.021
1.50	3.12	0.89	"	13.62	16.50	.826	.840	—.014
1.00	2.62	0.74	"	13.47	16.00	.843	.855	—.012
0.84	2.46	0.70	"	13.43	15.84	.848	.830	+.018
0.75	2.37	0.67	"	13.40	15.75	.851	.841	+.010
							Sum of errors	—.045
							Mean	—.007

* Gate *c* was used in these experiments. Whether the actual velocity of the efflux is increased by this gate or not, its effects are calculable upon such a supposition; we have, therefore, adopted $(.72)^2$ as a divisor in deducting the effective head corresponding to the distance between the bottom of the gate and the bottom of the bucket (.85 ft.)

† The fall is 14.15 ft., and the overshot coefficient is taken at .9 to facilitate the calculations.

The greatest difference between calculation and experiment being less than three per cent., the result may be considered as entirely satisfactory. The average error is but one per cent.

The accordance of the effects obtained from wheels Nos. I and II is thus shown to be complete, the effect of the increased proportion which the part where the water begins to escape from the wheel to the effective fall being, however, perceptible.

In the following table the results of experiments with wheels Nos. III and IV, are combined. The first was ten and the second six feet in diameter.

The form of gate by which water was admitted to the wheel having been changed,* the effective impulse for a given head above the gate is somewhat varied, but as the effect of this correction would merely be perceived in the cases of the higher heads, and as these differ but little more from the results of calculation, than the low ones, it has been thought better not to make any correction on this account.

TABLE TWENTIETH.

Comparison of the calculated with the observed ratios of effect to power, overshot wheels Nos. III and IV.

Head above gate.	Effective head of impulse.	Product of effective head by undershot coefficient.†	Product of fall from bottom of bucket to bottom of wheel by overshot coefficient	Sum of last two named products.	Head and fall.	Calculated ratio of effect to power.	Experimental ratio of effect to power.	Difference
Feet.	Feet.				Feet.			
0.25	1.87	0.52	8.46	8.98	10.5	.855	.817	+.038
0.75	2.37	0.66	"	9.12	11.0	.829	.809	+.020
1.75	3.37	0.94	"	9.40	12.0	.783	.758	+.025
2.75	4.37	1.22	"	9.68	13.0	.745	.710	+.035
3.75	5.37	1.50	"	9.96	14.0	.711	.670	+.041
							Mean difference	+.032

* For this gate, c, plate vii., Jour. Frank. Inst. vol. x., the ratios of the actual to the theoretical discharge per second, is : .62 : 1.

† Assumed at .28.

Comparison of the calculated with the observed ratios of effect to power, overshot wheel No. IV.

Head above gate.	Effective head of impulse.	Product of effective head by undershot coefficient	Product of fall from bottom of bucket to bottom of wheel by overshot coefficient	Sum of last two named products.	Head and fall.	Calculated ratio of effect to power.	Experimental ratio of effect to power.	Difference
Feet.	Feet.				Feet.			
0.25	1.68	0.47	4.95	5.42	6.5	.834	.810	+.024
0.75	2.18	0.61	"	5.56	7.0	.794	.793	+.001
2.75	4.18	1.17	"	6.13	9.0	.680	.645	+.035
3.75	5.18	1.45	"	6.40	10.0	.640	.604	+.036
							Mean difference	+.024

The calculated ratios exceed the observed ones less than three per cent. at a mean. The effect of wheel No. IV, appears rather better than that of No. III, perhaps, in part, from its having been raised so that the top was nearer to the gate.

It follows from these experiments that *low overshot wheels may be used to nearly the same advantage as high ones*, the diminution of effect when the wheels are duly arranged, amounting to but about three per cent., in a comparison between a wheel of twenty feet and one of six feet diameter. The conclusion on page 149, in reference to question 1, is thus shown to be applicable to low as well as high overshot wheels. As this is an important conclusion, the Committee will again consider the proofs afforded of it by the experiments.

The introduction of the virtual head of impulse in these calculations, while it is certainly more accurate in a theoretical point of view, tends to render the calculations more difficult in practice. A mode of calculating the effective power of an overshot wheel when the head and fall of water and the dimensions of the wheel are given, is desirable for practice; hence the following table has been compiled to show that, practically, the head above the bottom of the bucket may be used with the undershot coefficient, in calculating the effect of impulse, the fall below the bottom of the bucket being taken as the factor for the overshot coefficient. In fact, the less rigid mode of calculation produces results, on the average, more nearly in accordance with experiment than the other mode.

TABLE TWENTY-FIRST.

Comparison of the ratio of effect to power in overshot wheels under different heads, as calculated upon the head above, and fall below, the bottom of the bucket, with the ratio found by experiment.

Head above bottom of bucket.	Product of head above bottom of bucket by .28.	Product of fall below bottom of bucket by .9, added to preceding product.	Head and fall.	Calculated ratio of effect to power.	Observed ratio of effect to power.	Difference.
Overshot wheel No. I.						
3.60	1.01	18.47	23.00	.800	.828	—.028
2.10	0.59	18.05	21.50	.839	.842	—.003
1.35	0.38	17.84	20.75	.860	.845	+.015
					Mean	—.005
Overshot wheel No II.						
6.35	1.78	14.51	20.50	.708	.746	—.038
3.85	1.08	13.81	18.00	.767	.809	—.042
2.35	0.66	13.39	16.50	.811	.840	—.029
1.85	0.50	13.23	16.00	.826	.855	—.029
1.69	0.47	13.20	15.84	.833	.830	+.003
1.60	0.45	13.18	15.75	.836	.841	—.005
					Mean	—.023
Overshot wheel No. III.						
1.10	0.31	8.77	10.50	.835	.817	+.018
1.60	0.45	8.91	11.00	.810	.809	+.001
2.60	0.73	9.19	12.00	.796	.758	+.038
3.60	1.01	9.47	13.00	.728	.710	+.018
4.60	1.29	9.75	14.00	.696	.670	+.026
					Mean	+.020
Overshot wheel No. IV.						
1.00	0.28	5.23	6.50	.805	.810	—.005
1.50	0.42	5.37	7.00	.767	.793	—.026
3.50	0.98	5.93	9.00	.660	.645	+.015
4.50	1.26	6.21	10.00	.621	.604	+.017
					Mean	—.000
General average of the differences for the four wheels						+.002

The sums of the positive and negative errors in this calculation more nearly balance each other than in the former. A very easy practical rule is thence deducible for calculating the effective power of an overshot wheel.

If the ratio of effect to power in a theoretical overshot wheel, or one where allowance is made for loss by the head of water above the top of the wheel, as deduced from the high and low wheels, is the same as we have already found it to be, it follows, as before stated, that low wheels are as effective in practice as high ones, in proportion to the head and fall of water. To exhibit this by reference to the experiments themselves, and without additional calculations, the following table has been prepared. Part first contains a selection from tables sixth, (p. 149,) nineteenth, (p. 290,) and twentieth, (p. 291,) of those heads above the gate, which have a less ratio to the head and fall, than about one to six or seven. Under the separate designations of the wheels, are given the heads above the gate, the head and fall, the ratio of the head above the gate to the head and fall, and the observed ratio of effect to power. Part second of this table contains the same data differently arranged, namely, according to the order of the ratios of each head to the head and fall. The three columns of this second part contain the ratio just referred to, the designation of the wheel, and the ratio of effect to power, as found by experiment.

TABLE TWENTY-SECOND.

Part First.
Showing the ratio of effect to power with different overshot wheels, under different heads, bearing a small proportion to the head and fall.

Head above gate.	Head and fall.	Proportion of head to head and fall.	Ratio of effect to power.	Head above gate.	Head and fall.	Proportion of head to head and fall	Ratio of effect to power.
Overshot wheel No. I.				Overshot wheel No. II.			
0.50	20.75	.024	.845	0.75	15.75	.048	.841
1.25	21.50	.058	.842	0.84	15.84	.053	.830
2.75	23.00	.120	.828	1.00	16.00	.062	.855
	Mean	.067	.838	1.50	16.50	.091	.840
Overshot wheel No. III.					Mean	.063	.841
0.25	10.50	.024	.817	Overshot wheel No. IV.			
0.75	11.00	.068	.809	0.25	6.50	.038	.810
1.75	12.00	.146	.758	0.75	7.00	.107	.793
	Mean	.079	.795		Mean	.072	.801

Part Second.
Containing the same data as part first, arranged in the order of the proportion of head, to head and fall.

Proportion of head to head and fall	Number of wheels.	Ratio of effect to power.
.024	No. I.	.845
”	“ III.	.817
.038	“ IV.	.810
.048	“ II.	.841
.053	“ II.	.830
.058	“ I.	.842
.062	“ II.	.855
.068	“ III.	.809
.091	“ II.	.840
.107	“ IV.	.795
.120	“ I.	.828
.146	“ III	.758

The mean ratios deduced from part first of the foregoing table, if arranged in the order of the proportion of head to head and fall, would stand thus:

Wheel No. II.	**Proportion of**	**head to head**	**and fall,**	**.063.**	**Ratio of effect**	**to power,**	**.841**
I.	"	"	"	.067.	"	"	.838
IV.	"	"	"	.072.	"	"	.801
III.	"	"	"	.079.	"	"	.795

The increasing series of proportion of head and fall has corresponding to it a decreasing series of ratios of effect to power, in which wheel No. II, of fifteen feet in diameter, has a higher ratio than No. I, of twenty feet, and No. IV, of six feet, a higher ratio than No. III, of ten feet. The increase in the mean proportion of head to head and fall, between the first and last average, just given, is much greater than the decrease of ratio in the same cases. Taking the average of all the ratios of effect to power, given in part second of the last table, it appears that in calculating the effect of an overshot wheel, even as small as six feet in diameter, *eighty-three per cent. of the power may be taken for the effect,* provided the head above the gate does not exceed one-eighth of the head and fall, and the wheel is running so as to give the maximum ratio of effect to power.

The second deduction in regard to the overshot wheel, had reference to the ratio of the velocity of the wheel to that of the water striking it (page 150.) The following table gives a similar comparison for wheel No. II.

The velocity of efflux, of the water having been calculated, as explained on page 150, the virtual head corresponding to it, is obtained according to the principles laid down in page 153. To this is added the distance from the bottom of the gate to the bottom of the bucket, and the velocity of the impinging water, is calculated from this head.

In the table, the head above the gate, the whole effective head of impulse, the velocity of the water, the velocity of the wheel, and the ratio, are arranged in successive columns.

TABLE TWENTY-THIRD.

Showing the relative velocity of the Water and Wheel. Overshot No. II.

Table whence taken.	Head above bottom of gate. Feet.	Effective head of impulse. Feet.	Velocity of water. Feet.	Velocity of wheel. Feet.	Ratio.
a. I.	5.50	2.99	13.87	7.45	.54
"	3.00	1.89	10.74	5.55	.52
"	"	1.83	10.83	6.44	.59
a. II.	1.50	1.16	8.58	5.44	.63
"	"	1.14	8.50	5.66	.66
"	1.00	0.90	7.60	4.35	.57
"	0.84	0.83	7.31	4.72	.64
"	0.75	0.77	7.02	3.41	.48
				Mean	.58

This coefficient will be seen to be nearly the same with those obtained with gates *b* and *c*, in wheel No. I. The conclusion drawn before, as to the constant ratio between the velocity of the wheel and of the water, is entirely confirmed. The evidence is the more important because the head is in this wheel varied from three quarters of a foot to five feet and a half. The two extremes of the table vary most from the law, which is in favour of its accuracy, since in the one case, the distance gone through after leaving the aperture, bears a very small proportion to the whole effective head, and in the other case, is nine-tenths of it.

The apertures having been but little varied in the case of this wheel, it does not admit of conclusions in regard to the effect of the quantity of water or the velocity of the wheel.

We are enabled to compare the effective velocity of the gate c, used in this wheel, and *a*, *b*, and *c*, used with No. I, and the effect will be found favourable to the three last, and against c. Thus it appears from table tenth, that the velocity of the water striking the buckets was under a head of 2.75 ft., 13.89 ft., and 11.65 feet, with the gates *b*, and *c*, respectively, while with *c*, from the table just given, under a three feet-head, it was at a mean of but 10.78 ft., the fall after leaving the gate being the same in each case. In consequence of this, the velocities of this overshot wheel, do not, at a mean, come up to those of No. I, agreeing more nearly with the velocities given with gate *a*, than with the others.

There is nothing, however, in this to invalidate the conclusion above drawn, in regard to the relative velocity of the water and of the wheel.

It is plain that an increase of velocity must, in this wheel, produce a greater decrease of effect than in No. I, owing to the greater proportion which the head necessary to give the velocity required, will bear to the fall.

[TO BE CONTINUED.]

Technical Employment of Indigo. Part III. By J. C. Booth.

CONCLUDED FROM PAGE 231.

The indifferent character of indigo rendering it almost impossible to combine it with organic fibres, it is usual to submit it to one of two operations in order to effect its combination, either by reducing it to colourless indigo, or by solution in sulphuric acid, both of which processes were described in Part II. The modes of reduction vary according to the nature of the reducing material, for in the process referred to, it takes place in the cold, but where fermentation is resorted to, heat is usually applied.

1. *Copperas or common blue vat, cold vat.*—The principles of this process, as well as the mode of conducting it, were described in parts I and II, but the proportion of materials may vary according to their several qualities. Thus the following recipes are given among others.

Indigo,	1	1	1	6
Copperas,	2	3	4	15
Lime,	3	4	2	20
Potash,			2	4

The copperas should be as free as possible from peroxide of iron, which exerts no reducing influence, and from sulphate of copper, which would reoxidize the reduced blue colour. The lime is supposed to be in the dry hydrated state, that is, slaked with a quantity of water just sufficient to reduce it to a fine powder, and a due proportion of this hydrate should be employed, for an excess forms an insoluble compound with the reduced indigo occasioning an equal loss in the vat. This vat is adapted to silk, cotton, and linen, which are dipped into the yellow liquid after it has settled, suffered to remain in it a short time, taken out and exposed to the air, the oxygen of which acting on the reduced indigo, converts it into its characteristic blue shade. A weak bath and a single dipping may be sufficient for a light blue, but any desired shade may be attained by a more concentrated bath and more frequent dipping, observing to expose the fabric to the air after each dipping, until it receives its full depth of blue. After the last operation, the dyed materials are dried, treated with very dilute sulphuric or muriatic acid, to separate the lime, and finally rinsed in pure water. It appears then that the chief object to be attained by the reduction of indigo, is to render it soluble, so that it may enter into a fibrous texture, and then and there be converted into the blue by the operation of the air.

2. *Orpiment and tin vats.*—These are chiefly employed in printing goods, but their use depends on the same principles as those of the cold vat. For the former, one part finely powdered indigo, two parts potash, and 175 parts of water, are boiled; one part of freshly slacked lime is added, and the whole again boiled; and lastly, one part of orpiment (sulphuret of arsenic,) is added, and the mixture suffered to stand. It is usually thickened with gum, and applied by the hand or block. In this operation the arsenic and sulphur are oxidized at the expense of the indigo, which, in its reduced state, forms a soluble compound with the lime, while the generated acids of sulphur and arsenic combine with the potassa. The operation being tedious, and requiring much care in preparation, has given place to the frequent employment of oxide of tin instead of orpiment.

The following compositions are employed, the first for the block, and the second for cylinder printing.

Caustic soda lye,	= 3½ galls.	3½ galls.
Hydrated protoxide of tin,	= 5¼ lbs.	5 lbs.
Finely ground indigo,	= 3½ lbs.	3½ lbs.
Raw sugar,	= 21 lbs.	
Venice turpentine,		3 lbs.
Gum,		11 lbs.

The caustic lye should be of speci. grav. 1.15; the protoxide of tin is precipitated from a solution of protomuriate of tin by carbonate of potassa; the sugar and gum are used merely for thickening. The operation with the protoxide of tin depends on its affinity for oxygen, which converts it into the peroxide, while the indigo is simultaneously reduced and combines with soda. Turpentine is employed, in the second instance, in order to obviate the rapid reoxidation of indigo in the atmosphere; it being less necessary in the first case, since the mixture is kept more excluded from the atmospheric action. If a solution of muriate of tin be substituted for a portion of the precipitated protoxide, the mixture is less subject to oxygenation.

3. *Warm and fermented, or pastel, vat.*—Woad, indigo, madder, bran, potash, and lime, are employed, in this vat; the proportions of which necessarily vary; but the following may serve to show its usual composition; fifty woad, four indigo, three madder, two potash and caustic lime. The iron, copper, or wooden vat, is filled with water, and heated to 160° Fahrenheit, while the four ingredients are introduced; the temperature is maintained several hours, during which, slacked lime is gradually added, until one and one-third of caustic lime has been expended. The vat is now suffered to cool, during which, lime is again added in small portions. A fermentation ensues; the blue colour passes into green, and when the smell of acetic acid is perceptible, the liquid assumes a yellowish colour, and is ready for dyeing operations.

The theory of the process is analogous to that of the cold vat. The madder, woad, and bran, abounding in starch, sugar, gluten, &c., enter readily into fermentation in warm water, in order to maintain which, they abstract oxygen partly from the air, and in part from the indigo; the latter being thus reduced or deoxidized, forms a soluble combination with potassa, which is partially rendered caustic by lime. A portion of indigo-brown is dissolved with the blue, but is again precipitated by lime. Among other products of fermentation, carbonic and acetic acids are generated, which are neutralised by lime, and hence the gradual addition of this earth in proportion as they are produced. Woad simply dried, is better than the fermented

colouring material, for the latter is apt to become putrefied, an accident that sometimes happens, and may be remedied by more indigo and alkaline matter in the original proportion of ingredients. A quantity of lime should be added nearly sufficient to neutralise the generated acids, in order to keep the indigo in solution, and yet preserve a slight acidity in the bath, for if the fluid be alkaline it combines with the extractive matter, and forms an insoluble compound with indigo-blue, which is thus rendered inert. In a healthy state of the bath, therefore, lime has the property of rendering the potash more caustic and powerful, of precipitating indigo-brown, which would deteriorate the blue colour, of keeping the blue in solution, and of neutralising an excess of acidity.

4. *Urinous vat.*—This method of dyeing with indigo has been superseded in larger establishments by the preceding, and is now only practised on a small scale. Its operation depends on the fermentation of warm urine, by which the indigo is reduced, and combines with ammonia simultaneously generated.

5. *Potash vat.*—In this bath, indigo, madder, bran, and potash are employed, the last being added in several successive portions, while the bath is maintained at 122° Fahrenheit. The theory of the operation is similar to that of the pastel vat, excepting that only a small quantity of lime is added towards the close of the operation, to check fermentation, and precipitate indigo-brown. This vat is said to be superior to the pastel vat, although more expensive in materials, by requiring less time in dyeing, penetrating cloth better, by keeping sound for a longer time, and by requiring less outlay in its preparation.

6. *Sulphuric indigo vat.*—The theory of this solution was discussed in Part II. It is usually termed the Saxon blue dye, having been discovered by a Saxon of the name of Barth. As water prevents, more or less, the proper action of the acid, the fine indigo should be dried, and the sulphuric acid boiled, if it be not perfectly concentrated. One part of indigo is gradually added to six to eight parts of the acid, always taking care to prevent the mixture from becoming warm by keeping the vessel in cold water, where the temperature of the air is too high, for the action of the ingredients generates heat, and might destroy a portion of the blue colour. The mixture is suffered to stand thirty-six to forty-eight hours in a moderately warm place, which effects solution, and prevents the acid from attracting moisture. It may then be diluted with any desired quantity of water, and filtered, or drawn off clear. If goods be dyed in this solution, the red, brown, and glutinous matters of indigo are also attached to the material with the blue, which would therefore be deteriorated in its

beauty of shade. To avoid this, the indigo-blue (or ceruleo) sulphuric acid may be prepared by attaching it to wool, as described in Part II, washing with water, digesting in water containing a little carbonated alkali, and afterwards adding a little dilute sulphuric acid to the solution. By attaching it to the wool, gluten remains; by digestion with alkali, the indigo-red remains on the wool; and by the last addition of acid, indigo-brown is precipitated, while the alkali is supersaturated. The last clear solution communicates a fine blue colour to wool.

Probably the best method of preparing a fine blue is to add to the sulphuric solution of indigo about twenty times its volume of water, and add potash until one-fourth or one-third of the alkali is saturated. The ceruleo-sulphate of potassa precipitates, (see Part II,) which, being dissolved in water and acidulated, produces the finest Saxon blue. The liquid, separated from the precipitate, may be employed for a less perfect shade of colour. Materials to be dyed in the sulphuric blue vat should be dipped into a solution of alum, and then into the blue liquid, to which an excess of carbonate of potassa has been added, by which means a basic ceruleo-sulphate of alumina is attached to the fibres; or they may be dipped into a warm solution of chloride of barium and bitartrate of potassa, and then into an acid solution of the blue liquid, which produces a precipitate of neutral ceruleo-sulphate of baryta; the latter is more permanent than the former, but at the same time, more expensive.

It is difficult to ascertain the amount of indigo annually employed in dyeing, but it is probable it cannot fall short of 14 to 15,000,000 pounds. In England, about 1,700,000 pounds were imported in 1785, 3,600,000 in 1800, 5,000,000 in 1820, and over 7,000,000 in 1836.

Civil Engineering.

Letters from the United States of North America on Internal Improvements, Steam Navigation, Banking, &c., written by Francis Anthony Chevalier de Gerstner, *during his sojourn in the United States, in* 1839.

[Translated from the German, by L. Klein, Civil Engineer.]

[continued from page 255.]

LETTER X.

5. *Railroads in England.*

Although it is maintained that the oldest railroads were found in the mines in Germany, the merit of first having railroads used for the transportation of passengers, and of having introduced upon them

locomotive engines, belongs to the engineers and mechanics in England. It is only to be regretted that the immense cost of construction of the English railroads, and the expenses of working many of those where inclined planes have been adopted, have produced very unfavourable results for the Stockholders, and a bad impression on the subject of railroads on the continent. The railroad which is generally held up as an example for all others, viz. that from *Liverpool to Manchester*, is thirty-one miles in length, and has cost, up to the 31st of December, 1837, according to the report of the Directors, £1,360,095 stg., or per mile, 213,228 dollars. If the average be taken for the first three and a half years, during which the road has been in operation, the charge per passenger per mile, was three and three quarter cents, or one-fourth less than on the American railroads. Upon the Liverpool and Manchester railroad, there are transported, annually, 500,000 passengers, 250,000 tons of merchandize, and 100,000 tons of coal. The gross income was, in the year 1837, £226,000 stg., or per mile of road, 35,431 dollars, which income is indeed $11\frac{1}{2}$ times as large as on the American railroads, where it averages only 3075 dollars per mile; but compared with the cost of construction of 20,000 dollars, and 213,228 dollars per mile, we find the income in America to be fifteen per cent., and only one per cent. more on the Liverpool and Manchester railway. This explains why the net income of this road, upon which there is a greater traffic than on any other railroad in the world, was never more than seven to eight per cent. on the capital of construction; the Stockholders, though, received an annual dividend of from nine to ten per cent., but only for the reason that over £500,000 stg. have been obtained in loans at four per cent., the surplus interest on this capital therefore devolves upon the shares and increases the dividends.

The second great railroad, of 112 miles in length, extends from *London to Birmingham*, and cost £4,500,000 stg., or 195,000 dollars per mile. The other railroads in England generally cost less than these two, but still too much to serve as models for the works on the continent. Even in England, the shares of only five railroads are now over par, those of all other railroads are, notwithstanding the low rate of interest, sold below par. In the whole, there are now in England about 800 miles of railroads in operation, of which about 300 miles serve only for the transportation of coal. If to these 800 miles be added 300 miles for Austria, 150 miles for the other States of Germany, 150 miles for France, 159 miles for Belgium, and seventeen miles for Russia, we have, in total, 1576 miles of railroads now in operation in Europe, while, already at the close of 1838, 3000 miles of railroads were completed in the United States of America.

6. *Railroads in Russia.*

Until the year 1834, when I first went to Russia, the engineers there regarded railroads as quite impracticable for that empire. On my application, His Majesty, the Emperor, gave me an exclusive privilege for the formation of two railroad companies, the one for a railroad from *St. Petersburg to Zarskoe Selo*, and the other, for one from St. Petersburg to Peterhof. I formed afterwards a company for the establishment of the first railroad, and the charter for the same was granted on the 21st of March, 1836. Soon after the construction of the road was commenced, it was partly opened already on the 21st of September, 1836, and the whole line was put into operation on the 30th of October, 1837. This railroad is only seventeen miles long, but forms, in its whole length out of the city of St. Petersburg, a straight line; the greatest rise is within the city, and but 10½ feet per mile. An embankment was erected the whole length of the road, which contains over one million cubic yards; this embankment was covered with a bed of stone and gravel, fourteen inches high, upon which the cross ties or sleepers were laid three feet from each other, supporting iron rails of sixty-five pounds per yard, which were fastened in chairs upon every sleeper. The space between the cross ties was then filled in with broken stone or gravel, and covered with sand. The grandeur of the whole structure was in correspondence with the expected traffic, as it was estimated that 300,000 passengers each way, or 600,000 in the whole, will travel over this road in one year. But this solidity in the construction, the high price of the iron in the year 1836, and of the stones and gravel in the marshy district of St. Petersburg, as also a great many unforeseen expenses, which generally take place in a new enterprize of this kind, increased the cost of construction so much, that for the road itself of seventeen miles in length, with a single track, 4,000,000 of rubles were expended, which is 50,000 dollars per mile. This comprises, however, the purchase of six locomotive engines, forty-four passenger cars with 1878 seats, and nineteen freight cars. The company having got permission to erect a large hotel in the park, at Pawlowsky, and another at Zarskoe Selo, they expended for these two hotels, and for some other buildings, 1,000,000 of rubles; therefore, in the whole, 5,000,000 of rubles, or 1,050,000 dollars.

During the winter of 1837—1838, the Directors of the Company permitted only a few trips to be made during some days of the week; the daily regular trips between St. Petersburg and Zarskoe Selo, commenced on the 4th of April, and those to Pawlowsky, on the 22nd of May, 1838. According to the printed report, made to the

Stockholders at their general meeting, the results of the operations of this road for the year 1838, have been as follows, viz:

The number of passengers from 1st April to 31st December 1838, was - - - - -	597,665
If reduced to the whole length of the road, this number is equal to - - - -	423,129
The total receipts from passengers, were -	161,872 dollars.
Each passenger paid, therefore, at an average, for seventeen miles, - - - -	38¼ cents.
Which gives the average charge, per passenger per mile, - - - - -	2¼ cents.

The number of trips made by the locomotives, was 3500, and the average number of passengers per trip, 121. All the trains together, performed, therefore, a distance of 59,500 miles. The current expenses have been:

For maintenance of way and buildings, -	$ 23,485
Transportation account, - - -	36,810
General expenses, cost of administration, &c.,	30,340
Expenses for amusements, - - -	14,226
Total,	$ 104,861

If this sum be compared with the number of miles traveled by all the trains, or 59,500, we find the expense per mile of travel, equal to 180 cents. In Belgium this expense is only 105 cents, and the trains contain, at an average, 143 passengers. In America, the expense per mile of travel, is only 100 cents, while the average number of passengers in a train, is forty.

The expense per mile of travel, 180 cents, divided by 121, gives 1.49, or nearly one and a half cent as the expense per passenger, per mile, which is twice as much as on the Belgium railroads.

The gross income during nine months, was 161,872 dollars, the net income, according to the accounts, 63,068 dollars, or thirty-eight per cent. of the gross receipts. The Stockholders received a dividend of four per cent. for these nine months.

The Directors mention in their report, that during the *whole* first year the road has been in operation, the number of passengers was 707,091, and the gross income 193,734 dollars. For the next year they estimate the income at 23,579 dollars, and declare, that there is a prospect, the net profit will be over forty per cent. of the gross revenue. In this case, the net profit would be 92,632 dollars, and after deducting 18,947 dollars for the interest and sinking fund on the loan, there will remain 73,685 dollars as dividend for the Stockholders, or exactly ten per cent. on the capital stock of 736,850 dollars. The

whole result of the operations agree very accurately with my first estimates; the number of passengers reduced to the whole length of the road, will be 600,000 per year; and already three years ago, I offered the company to rent the rail road, and pay the Stockholders during three years, a dividend of ten per cent. per annum.

The experience in the management of railroads during the last three years, has, however, shown that the expenses are much larger than was formerly expected, and at the present time, when this experience from the railroads in Europe, and a much greater one from those in the United States is before me, I must declare that it is quite impossible to defray the current expenses of the Zarskoe-Selo railroad, as it is now managed, with sixty per cent. of the gross income. As yet, this railroad is not reduced to its own resources, because the Directors proposed to make another loan of 300,000 rubles, (63,158 dollars,) to complete the same; and as long as money is expended at the same time, for the construction of the road and its operations, there can, even with the best will, never be made a strict division of the expenditure. No accurate results concerning the expenses of the operations of the Zarskoe Selo railroad, will therefore be obtained in 1839, and as long, hereafter, as the construction account is not entirely closed.

Several months since I proposed to the Directors, some arrangements and improvements, from which none but the best results can be expected. They consist, principally, in the following:

1. To continue the railroad from its present termination, to, and along, the Fontanka canal, a few wersts, in order that passengers might be taken from different points in the city, and brought, by horse power, to the general depot. All the large cities in the United States, as New York, Philadelphia, Baltimore, and New Orleans, are traversed by railroads, which, with a peculiar construction, turn round the sharp corners of the streets frequently with a radius of only forty feet, and the eight-wheeled cars, of fifty-two feet in length, never run off the track. The advantage of continuing the railroads through cities, is very great for the Stockholders and the public in general, principally where the lines are short.

2. To introduce eight-wheeled passenger cars and American locomotive engines, and to apply to their purchase the reserved fund, which, according to the statutes, is to be from ten to thirty per cent. every year of the gross income, and destined for the renewal of the depreciated stock.

3. To use wood as fuel for locomotive engines. The coke hitherto used as fuel upon this road, is imported from England at a very high price. There is no coal between St. Petersburg and Moscow, and it

can never be expected that the fuel for such an immense railroad as that between those two cities, will be procured in the same way. My attention in America was therefore also directed to this subject; upon more than 100 railroads, wood is used here as fuel, and it was to be expected that something effective had been invented, to prevent the throwing out of the sparks. It was principally in the South, under the thirtieth degree of latitude, that I found an apparatus in use, which seems to answer perfectly in every respect. By means of this apparatus the sparks are led through a partial vacuum, and fall down to the bottom of the smoke box; there is no wire net on the top of the chimney. This apparatus has been in operation for eighteen months, during which time not a single accident occurred, although cotton and other articles are daily transported in open cars. It is easy to show that by the use of wood as fuel upon the Zarskoe Selo railroad, the sum of 10,000 dollars might be saved in one year.

It is only with the introduction of the above stated improvements, that the Stockholders of the Zarskoe Selo railroad may expect a dividend of ten per cent. per annum, and as I am now so well acquainted with the experience in America, I do not hesitate to offer them again a yearly dividend of ten per cent. for the next three years to come, to pay besides, 90,000 rubles per year as interest and sinking fund on the loan, and to pay for the general depreciation of the locomotives and cars, an American train consisting of a locomotive with tender and a number of passenger cars to accommodate 400 passengers.

The advantage of the construction of the Zarskoe Selo railroad to the Russian empire, is far greater than to the Stockholders therein interested; because this railroad has been used in the changeable climate of St. Petersburg, in summer and winter, without the least interruption, the trips were regularly continued during the time of the greatest frost and the severest snow storms, and every body became convinced of the practicability and usefulness of this new kind of communication. This favourable result has produced the effect, that the project for a railroad from *St. Petersburg to Moscow,* which I brought into notice already three years ago, finds every day more and more supporters, and at present there are certainly but few individuals in Russia, and none abroad, who, with the knowledge of the intercourse existing between the two cities, are not convinced of the utility and necessity of this railroad. The population of St. Petersburg is 470,000, that of Moscow 330,000; the population of the towns and other places on the road, exceeds 200,000 souls. This railroad would therefore, in its length of 420 miles, form a line of communication for one million of inhabitants, residing on the same; and besides, the railroad would be traveled over by those numerous

travelers, who, from all parts of the empire, pass through Moscow to St. Petersburg.

The enormous intercourse between the two cities, which is not to be met with on any other line, neither in nor out of Europe, may be best judged of from an account kept, by order of His Majesty the Emperor, of all vehicles which passed over the turnpike from the 1st of January to the 31st of December, 1834. In that year, there were counted at Tshetire-ruki, on the turnpike road to Moscow, five miles from St. Petersburg:

	96,201	traveling carriages of every description, drawn by - - -	269,799 horses.
	23,879	post carriages and post sledges,	62,171 "
	1,133,603	freight wagons or sleighs, drawn by - - -	1,187,402 "
Total,	1,253,683	vehicles, drawn by	1,519,372 horses.

This intercourse is so great, that it would justify the construction of a railroad more than it was ever the case in any line of this length; it remains only to inquire what would be the cost of construction of this railroad.

The Americans have constructed 3000 miles of railroads, and expended for the same, at an average, 20,000 dollars per mile; as only 35,000 passengers, and 15,000 tons of goods are transported annually over these roads, they have but single tracks, and the whole management is such, that the capital of construction bears five and a half per cent. interest. The traffic upon the St. Petersburg and Moscow railroad will be at least ten times as great, and therefore a much larger capital may be invested there than in America.

Already in the year 1835, I personally made a preliminary survey of the country between St. Petersburg and Moscow, and convinced myself that in the greatest part of the line the country is uncommonly favourable; since that time, I have continued to collect every important information in regard to this railroad, and with the knowledge of the experience in America, I may state without hesitation, that a railroad from St. Petersburg to Moscow, with a double track, with as heavy rails as those upon the Zarskoe Selo railroad, with all the necessary buildings and outfit, may be established for the sum of 125,000,000 of rubles, (26⅓ millions of dollars,) and that I will undertake to finish the whole railroad in a term of not more than six years.

It will, perhaps, be objected, that the Zarskoe Selo railroad, of 17 miles in length, with but a single track, has cost 5,000,000 of rubles, that therefore, in proportion to the length, the 420 miles to Moscow must

cost 125,000,000, in which sum would be comprised, it is true, the purchase of the proportional number of 150 locomotive engines and of 1600 passenger and freight cars, but the railroad could only have a single track. I have had occasion to remark already, in my former reports, that the cost of one railroad can not lead us to determine the cost of another, as the expenses of construction can only be ascertained by the special estimates; but here it may also be remembered that of the whole cost of the Zarskoe Selo railroad, the fifth part was expended for buildings alone, which, in proportion to the length, would give 25,000,000 rubles for the railroad to Moscow. The cost of the buildings for this road, however, as they will be constructed solely to accommodate the traffic, and not for amusements, will not be more than 4,000,000 rubles, and the remainder 21,000,000 are, with the present prices, just sufficient for making the superstructure of the second track throughout the whole line. There only remains therefore, the expense of grading for the second track to be provided for, and this sum will be richly brought in by the introduction of such a construction of the railway as will conform to the present experience in the two continents.

The connection of the centre of the Russian empire with the most important commercial city in the South—of *Moscow with Odessa*—has also been hitherto regarded as highly important. The construction of a canal is quite impossible; the construction of a turnpike, and more yet, its maintenance, would, with the entire deficiency of stone and gravel, be too expensive. Nearly all the railroads in the Southern States of North America, as also those in Belgium, are constructed without stone or gravel, because the latter are as rare there as in Russia; and in every case, would the maintenance of a railroad between Moscow and Odessa be cheaper than a macadamized road. The distance between the two cities is about double that from Moscow to St. Petersburg, and as the country is, throughout, very level, there is no difficulty to construct this railroad, with a double track, and heavy rails, for 175,000,000 of rubles, (or 37,000,000 of dollars) at the most. Both railroads could easily be completed in ten years.

A third railroad, which is supported, principally, by the population of Moscow, is that from *Moscow to Kolomna*, and the river Oka. The surveys and plans for this railroad were made by several engineers, during three years, from 1836 to 1838, with all the necessary detail, under my superintendence, and the estimates now completed. The length of the railroad to the river Oka, is $66\frac{2}{3}$ miles, and plate rails of sufficient strength, (manufactured in Russia,) might be employed for the same. The railroad would have a single track with sidings, and the arrangement be such that no inconvenience would

be experienced in the operations. The passengers, and no doubt, also a great quantity of goods, would be transported from the end of the railroad upon the river Oka to Nishney Novgorod, situated on the confluence of the rivers Oka and Wolga, where, annually, the celebrated great fair is held for the merchants of Europe and Asia. According to my estimates, made here, the railroad and four steamboats, would cost 11,000,000 of rubles, (2,315,800 of dollars,) and I offer to complete the road in two years, provided that I meet with no obstacles in directing the construction.

The way in which the above mentioned capitals for the construction of the railroads, may be procured, will be easily found out, if my former nine letters are read with attention. Sixteen millions of Americans have, within ten years, completed 3000 miles of railroads, at an expense of 60,000,000 of dollars; why should not Russia, whose European possessions are as large as the United States, and populated by three times as many, or 48,000,000 of inhabitants—why should this immense empire not also expend, in ten years, the sum of 60,000,000 of dollars for the railroads between St. Petersburg, Moscow, and Odessa. In Belgium, 56,618 soldiers were carried, last year, upon the railroads; what a gain would not result to the Russian war department alone, from the establishment of railroads! With the adopted width of track of six feet, and the introduction of the American plans of construction, horses, cannons, munition, wagons, and all other objects, will be transported with the greatest facility, and it might be proved, that the saving in the cost of transportation of the Russian troops and their munitions, during the late three wars with Persia, Turkey, and Poland, would have covered the whole cost of construction of the railroad from St. Petersburg to Odessa; and besides, the duration of the war would have been materially shortened.

Times were never more favourable for great enterprizes; Europe is in the enjoyment of profound peace; money may be obtained at the lowest rate of interest, and will be easily procured for the Russian undertakings, if to their partakers, advantages and guarantees are allowed, similar to those given in other parts of Europe, and in the United States of America. In such large undertakings, however, for which more than the ability of the natives is required, the question of nationality must be laid aside, and every body must be regarded as a native, who has made himself meritorious by the introduction of useful objects, which promote the prosperity of the nation. The Russian government has, principally in the last four years, accomplished what may be termed enormous; it can, and will, therefore, also execute that grand and national work.

Extracts from the Treatise on Geodesy. By L. B. FRANCŒUR. *Translated by* W. H. EMORY, *Lieut. U. S. Topographical Engineers.*

[Translated for the Journal of the Franklin Institute.]

The translation of Francœur's work on Geodesy, was commenced for the purpose of improving the translator's knowledge of a subject which forms a part of the duties of his corps. It has since occurred to him that the work would be useful to the public.

The frequent demands made by the general and state governments for topographical information with regard to particular localities, induces the belief that at some day not far distant, our legislatures, both state and national, will follow the example of other civilized governments, and consummate the desirable object of having complete maps of the territory within their respective limits.

The great survey of the coast undertaken by the general government, and conducted by Mr. Hassler, is, in fact, the commencement of this system, and will form the basis of all minor surveys of the different states and the inland frontier.

Even with the present demand for information upon the subject of surveying, the work cannot be unacceptable, as it will tend to give form, precision, and consistency, to surveys conducted for internal improvements and local purposes.

The name of the illustrious author, Francœur, renders unnecessary any commendation of his treatise. It may not be improper to say, however, that it is considered in Europe, the standard work on geodesy.

The valuable notes interspersed through the text, are by Major Bache, of the Topographical Engineers, to whom the translator feels an obligation which he is sure will be shared by the reader.

Book 1*st.—Topography.*

1. If we take a portion of country and suppose perpendicular lines to pass through every point, the intersection of these lines with a horizontal plane will form what is called the plan. The projection of the plan is composed of these intersections represented on paper. In this are to be traced the sinuosities of rivers and roads, the outlines of woods, the boundaries of fields and enclosures, and all the other features of the country, both natural and artificial.

Every part, when represented, preserves its true relation of size, form, and distance, reduced by a scale, and presents the same appearance as if the whole of the objects were seen at the same time from a great elevation, with a glass, which diminished their size.

Topography teaches the projection of plans, leveling, and land surveying, or the measurement of areas, and the art of delineating ground. This last division not involving geometrical considerations, will be omitted in this treatise.

Chapter 1st.—*The Projection of Plans.*

We shall explain the construction and use of the different instruments required in topography, except those used in geometrical drawings, such as the rule, the triangle, the dividers, the drawing pen, &c., which are too well known to require a notice here.

The art of projecting plans consists chiefly in a knowledge of instruments, and the merit of the surveyor depends, in a great measure, on his skill in using them.

2. *The Scale.*—Every plan should be accompanied by a scale, which shows the proportion the plan bears to the ground. The most usual way of making a scale is to draw on the plan a right line, which is divided into equal parts, and numbered; each part designating an unit, as a mile, a foot, an inch, or a tenth of a foot, &c. In Fig. 2, plate 1, one of these parts is divided into tenths. If it is required to take off four units and six tenths, place one leg of the dividers on the division No. 4, and the other on the subdivision No. 5, on the left hand of zero. If the unit represents a foot, we obtain four feet and five tenths, or fifty-four inches; if a mile, four miles and six tenths.

The relation between the distances on the plan and the objects themselves, is frequently expressed by a fraction. If for example, a foot on paper represents a mile on the ground, the scale of the plan may be expressed by the fraction one five thousand two hundred and eighty; a foot being the $\frac{1}{5280}$ part of a mile.*

The plans of the great map of France, by Cassini, are on a scale of $\frac{1}{86400}$, a line [.091 of an inch,] representing 100 toises, [221.5 yards.] The scale adopted by the war department, is $\frac{1}{80,000}$, a millemetre, [.3937 of an inch] representing eighty metres, [87.491 yards.] The scales used in the *cadastre*,† are $\frac{1}{5000}$, $\frac{1}{2500}$, and $\frac{1}{1250}$, and as the ground is more or less cut up into small parcels, a millemetre, [.3937 of an inch,] representing in these cases, 5, [5.4658 yards,] $2\frac{1}{2}$, [2.7329 yards,] or $1\frac{1}{4}$ metres, [1.3664 yards.]

3. When great precision is required, the transversal scale‡ is used. Fig. 3 is a scale of this kind. The least part that can be measured is

* The French now use a metrical system, viz., a myriametre, a kilometre, a hectometre, a decometre, a metre, &c., each unit of division being a tenth of the next greater one.

† The public register, in which is recorded the quantity and value of lands (like the doomsday book in England.)

‡ Commonly called diagonal scale.

extremely small, as it is contained 100 times in each principal longitudinal division, or ten times in every sub-division. The oblique lines enable us to measure the small parts in the following manner. Place one leg of the dividers on the transverse line marked 300, and the other upon the oblique one numbered eighty, the distance being measured along the longitudinal line No. 4, (for it is necessary that both legs of the dividers should be on the same longitudinal line,) the length measured will contain 384 parts, which will be 384 tenths of inches, feet, yards, or miles, according to the value assigned to the unit of division.

4. *The Protractor.*—This instrument, represented in figures 5, 6, and 8, is used to trace angles on paper, or to measure them when traced. It is a semicircle of brass or horn, divided into degrees and half degrees, from 0° to 180°. It is numbered either from the right or the left, and on a concentric semicircle it is numbered in a contrary direction, from 180° to 360°, in order to measure the arcs, which exceed 180°.

To measure an angle already traced on paper, apply the diameter of the protractor to one of the sides, A C, (fig. 7,) so that the centre shall be on the apex C of the angle, the other side, C K, cuts the circumference in a point, K, where we read the angle, which is 54°.

To construct an angle L O K, (fig. 6,) of an even number of degrees, thirty-six for example, place the protractor so that the radius of the thirty-sixth degree shall fall on the line I K, which is to be one of the sides of the angle, and at the same time, place the edge *ab* on the point E, through which we wish the other side to pass. The line L O, which, by the construction of the protractor, is parallel to the diameter A C, will make an angle of 36° with the line O K.*

These protractors, however, afford but an imperfect means for measuring or constructing angles, and as an improvement, that represented in fig. 8, has been contrived. It consists of a graduated semicircle as before, with a movable rule, to which is attached a vernier, by the aid of which minutes can be read, (vide No. 9, on the use of the vernier and its construction.) The centre of the circle is in the middle of an opening, which is defined by the crossing of two hairs. Care must be taken in the construction of the instrument that the edge I D of the

* In this example the angle is drawn through a point removed from the given line. A more frequent case is where the point is on the line. Then the diameter of the protractor is placed on the given line, with the centre at the point, when the required angle is marked off. A perpendicular to the given line should be drawn, in the first instance, through the point, to guide in laying down the protractor in its true position, as the line passing through the graduation at 90°, should be coincident with it.

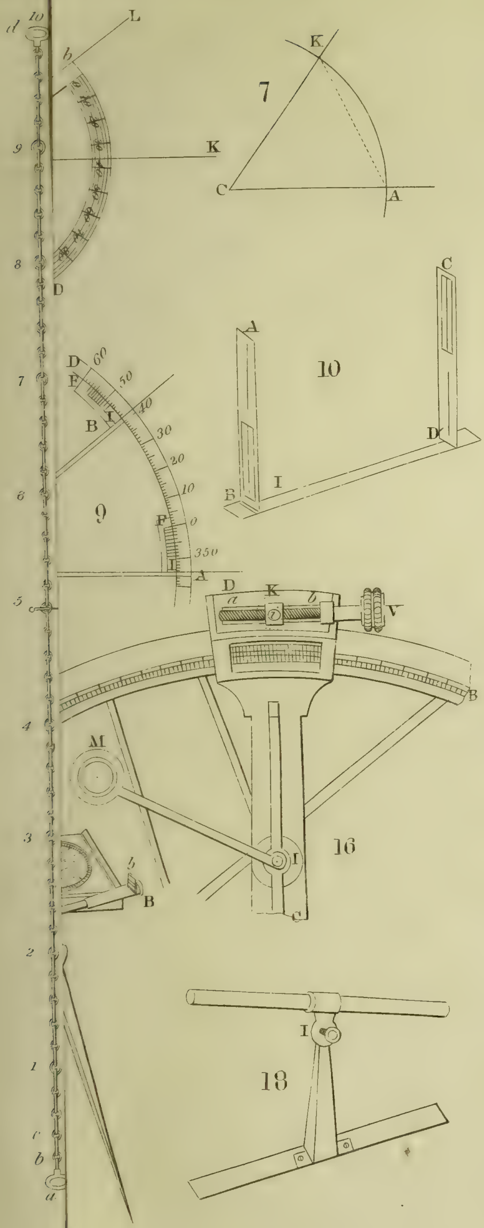
rule prolonged, shall, in all its positions, pass through the centre of the circle*. However, it is still more exact to use a scale of cords. Fig. 4 is a scale of cords. To use it, describe first the arc of a circle, A K, (fig. 7,) with a radius equal to the cord of 60°, (taken from the scale,) which we know is the side of the inscribed hexagon; then take from the scale, with the dividers, the cord of the given angle, 54° for example, apply it to the arc described, and the radii drawn through the two points, A K, where the points of the dividers touch the arc, will make with each other the required angle. To save space, fig. 7 is drawn from scale fig. 4: the distances being reduced to one-fifth.

To give this construction greater precision, in place of taking the length of the cord from fig. 4, calculate the length in parts of the radius by means of the equation No. 35, or take the numerical value from the table, (see Francœur's course of Math. and his Geometry;) then take this distance with the dividers from a decimal scale, which will be the length of the cord to be applied to the arc A, K. Thus the cord of 54° is 9080, the radius being 10.000: with

* The circular protractor is a still more perfect instrument, and gives results of far greater accuracy. It is numbered throughout the entire circle from 1° to 360°, and reads by means of verniers to one minute, 30, 15, and in some instances, to 10 seconds; the diameter of the instrument varying according to the minuteness of the divisions. It is furnished with arms provided with points, by means of which the given angle is marked on the paper. These arms, for safety and convenience in transportation, fold up on the body of the instrument. This protractor has the advantage, not possessed by those less than a circle, of correcting by means of opposite verniers, the errors of eccentricity, &c., which belong, more or less, to all graduated instruments. It is, likewise, susceptible of ready adjustment, and is not easily deranged. The movement of the arms is effected by a pinion working on a fine ratchet on the periphery of the circle. For laying down the protractor on any given point, four short lines are marked on the interior edge of the principal circle, which indicate the prolongation of two lines at right angles to each other, and intersecting at the centre of the instrument.

The description of another protractor, and one which has found general favour for railroad, canal, and other surveys, within the last few years, may not be unacceptable in this place. It is likewise circular, and consists of a printed sheet so designed, by means of lines of unequal lengths, that the divisions of 10°, 5°, and 1°. and the fractional parts of a degree, readily catch the eye. It is prepared without letters or figures, in order that the draftsman may assume any one of the principal divisions for the zero or meridian line, as best may suit his purpose. The original plate for printing these protractors, was engraved in 1829, and had a circle of twelve inches in diameter graduated to fifteen minutes. It was sufficiently large to print on medium paper, without leaving any marginal ridge, which is always made when the paper is larger than the plate. To avoid the error which would otherwise occur, the impressions are obtained on dry paper; though this precaution is not sufficient to secure absolute accuracy to the protractors, as the great pressure necessary to give the lines sufficient distinctness, stretches out the paper unequally, which, on coming from the press, assumes its original form. The figure thus becomes slightly elliptical, but not so much so as to offer any practical objection to the usefulness of the plan. The facilities which this protractor affords in plotting, generally, will readily suggest themselves. It is hardly necessary to say, it is not intended for use in final drafts or maps, but to obtain results to be transferred to them.

Plate I.


7
K
C
A
L
b
K
D
10
A
C
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B
9
D
F
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I
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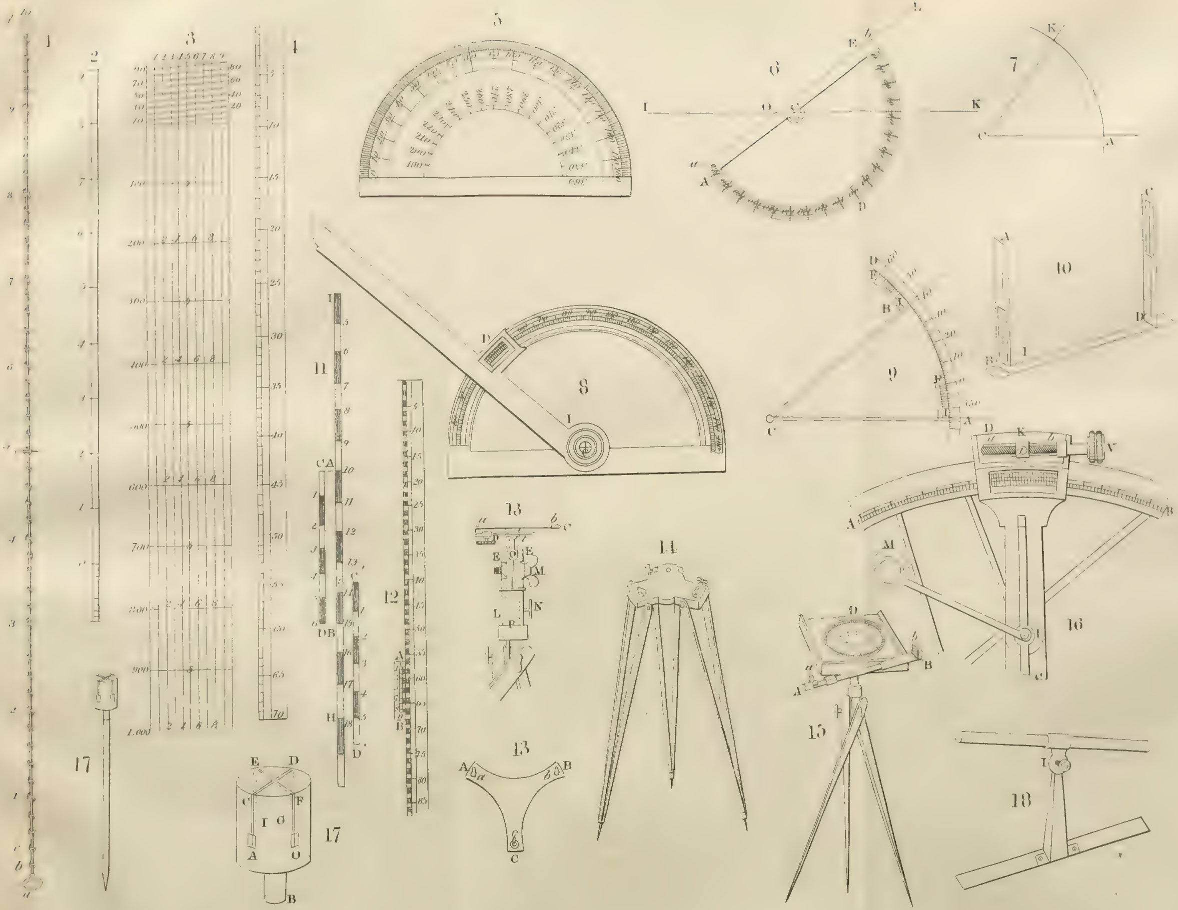
10



a radius of 10,000 parts of any scale, describe the arc A K, upon which apply the cord A K of 9080 parts of the same scale.

5. *Signal Staves.*—These are straight poles shod with iron that they may be stuck in the ground. A small white board or a sheet of paper is fastened to these staves when it is required to see them at a great distance.* They are planted in different parts of the country as signals, and may be used to run straight lines, by an observer getting two of them in range, while an assistant under his direction places others at intermediate points.

The Chain.—Short distances are measured with a rule; long distances with a chain. The chain is formed of links, or more properly of rods of large iron wire turned at the end into small loops and connected with each other by rings. The length of a link measured from centre to centre of the consecutive rings, is six inches. There are 100 links in a chain, so that a chain is fifty feet in length.† Each end of the chain has a handle which makes a part of its total length. For convenience in measuring distances less than a chain, there are brass markers at every ten feet.

The effort which is constantly made to stretch out the chain in useing it often increases its length. It is therefore necessary to submit it frequently to some test, such as applying it to the exact distance marked on a wall or floor, in order that the operator may be assured that the chain is of the proper length.

The operation of measuring is performed by two chain bearers, called *leader* and *follower*, and is commenced by placing poles in the direction to be measured. Departing from the first pole, the *follower* holds his handle on the ground at the point of departure *a*, (Fig. 1,) and the *leader* proceeds on the line in the direction of the second pole; taking out any kinks in the chain, and avoiding stones, tufts of grass, or any thing that may derange its right line direction. He then sticks a pin in the ground at the extreme point *d* of the chain. The pin is a piece of iron wire with a loop‡ at the end for the purpose of suspending it from the person by a hook. The pin being stuck, the chain-bearers proceed, the *leader* dragging the chain until the *follower* ar-

* Small white flags, or flags of white, red and black, of different sizes and shapes, and variously combined, form good signals and are easily distinguished one from another.

† In the original work, this chain consists of 50 links of two decimetres each, or 100 decimetres. An addition of five millemetres (.19685 of an inch) is made in the length, (32.81 feet nearly) to compensate for the thickness of the ring, and the difficulty in stretching the chain.

The fifty feet chain is used in the United States for military, railroad and canal surveys, and the two and four pole chains for land surveying.

‡ This loop is also useful to attach small strips of white or red cloth, to guard against losing the pins in bushes, cane-brakes, high grass, &c.

rives at the pin, when he places his end of the chain against it, and the *leader* stretches the chain and fixes another pin, and so on to the end. The *follower* takes up each pin as he comes to it, and keeps it; the number he gets denoting the number of chains measured. If the distance exceeds ten chains, the *follower* on taking up the tenth pin, returns the whole ten to the *leader*, and records it in his book.* The distance of ten chains thus noted is called a tally. Every measurement should be taken parallel to the horizon. When the ground slopes, or there are impediments, the chain must be held horizontally above the ground. But as the chain swags from its own weight, this is impracticable, and the measurement is therefore not entirely exact.

Alidade.—This instrument is of various forms, but in describing one, all the rest will be easily understood. It is a movable rule which is directed towards different objects, whose relative position we wish to determine, taking the objects as points to sight upon. This rule (fig. 10) has at each end perpendicular limbs A B, C D, which can be removed at pleasure for the convenience of transportation. These limbs are called pinnules, or sights. A, is a very narrow vertical slit, to which the eye is applied, and opposite is a rectangular opening, in the middle of which, and perpendicular to the rule, is stretched a thread of silk or a horse hair. The plane passing through this thread and the slit opposite passes likewise along the edge I D, of the rule. As it is convenient to use the sight which is nearest, both are provided with a slit, and a rectangular opening and thread; the slit in one of them being placed below, and in the other above the rectangular opening.

To see a signal, turn the alidade in the direction of the object, so that the visual rays which pass through the slit and the thread shall coincide with the object. The plane of these visual rays is perpendicular to the plane of the rule, and should also coincide with its edge I D. To verify the fact, direct the instrument on an object, and draw a fine line along the edge of the rule; then turn the alidade, end for end, and, if in adjustment, its edge will coincide with the line drawn; should this not be the case, the thread must be moved until the error disappears.

Instruments used in measuring angles, which have arcs of circles, are similar in some respects to alidades; but they have a movement about a centre, (see what follows and fig. 22.)

8. When signals are too distant to be observed with the naked

* If eleven pins are used, which is a better number, the ten pins forming the tally are returned to the leader on the eleventh pin being stuck in the ground, and which then becomes the first pin in the next tally.

eye, a telescope is used in place of the simple sights. It contains two lenses, one towards the object, called the object-glass, and the other towards the eye, the eye-glass. The two glasses are placed at such a distance apart that their respective foci are nearly at the same point in the interior of the tube. In this focus, common to both, is a diaphragm, across which two threads are stretched at right angles to each other. This diaphragm is movable along the tube of the telescope, and can, by this means, be placed exactly in the common focus of the two glasses, (see 103.)

When the telescope is directed on an object, the signal should appear directly on the intersection of the hairs, or in coincidence with one of them. This telescope inverts objects, but no inconvenience results from this circumstance. It is mounted on a stand, above the alidade, and has a motion in a vertical plane.

9. *Vernier, Nonius.*—The fractional part of a division of an instrument divided into equal parts, is read by means of a small metallic plate, which moves in contact with the divisions, and is itself divided into equal parts. If the space occupied by $n-1$ of the principal divisions be divided into n parts on this plate, the nth part of the length of the principal division can be read by the aid of it. This contrivance is called a *vernier*, or *nonius*, after two geometricians, one of whom invented, and the other brought into general use, this valuable auxiliary to accuracy. The theory of the vernier is given in the following article.

H A I (fig. 11) is a fixed rule, divided into equal parts . . . 8, 9, 10 . . .; the small rule C D, which has a motion parallel to and along the first, is just the length, for example, of five of these parts, and is marked in six equal divisions, and numbered. Let us suppose the extremity C coincides with the 10th division. If we take one of the divisions of A B for a unit of measure, and compare the divisional lines of A B, and C D, we see that No. 1 of the small rule is higher than No. 11 of the large rule, by $\frac{1}{6}$ of the division assumed as unity; No. 2 is higher than No. 12 by $\frac{2}{6}$; No. 3 is higher than No. 13 by $\frac{3}{6}$; No. 4 higher than 14, by $\frac{4}{6}$; No. 5 higher than No. 15 by $\frac{5}{6}$; and lastly, that No. 6 is higher than No. 16 by $\frac{6}{6}$, or 1; that is to say, No. 6 corresponds exactly with the 15th division of the rule.

Now let the small rule C D, which is the vernier, be placed on the other side in the position C′ D′, and find the value of the fraction which is marked off at C′, or in other words, the length 13 *i*. To do this, see on the vernier and the rule what two divisional lines exactly coincide. In this instance No. 5 coincides with H, from which we conclude that the length 13 *i* is $\frac{5}{6}$ of a division of the rule H A, and that the point C′ reads 13 units and $\frac{5}{6}$ of a unit. For No. 4 is below 17, ;

No. 5 below $16,\frac{2}{6}$, and so on to C′, which is below $13,\frac{5}{6}$. The No. 5 on the vernier which designates the division in coincidence, indicates the numerator of the fraction $\frac{5}{6}$ without taking the trouble to count the parts one by one. The units are here divided into sixths, because five of these units are divided into six parts on the vernier. Figure 12 is constructed on the decimal principle, nine parts of the scale making 10 of the vernier A B. According to this, the line *i* reads 57 units and $\frac{6}{10}$; the fraction being ascertained by remarking that the divisional line, No. 6 on the vernier, is the only one which corresponds with any divisional line on the scale.

The same reasoning applies to the case of a circle divided into equal parts (fig. 9.) Suppose the arm A C with the vernier I F fixed to it, movable around the centre C of the graduated arc A D. This vernier is terminated by a concentric arc which moves in contact with the divisions on the limb in every position of the arm A C. An arc of nine degrees of the large limb, embraced between I and F, and divided into 10 equal parts on the vernier, will read tenths of a degree. If the vernier is placed so that the last divisional line corresponds with the zero point of the graduated limb, the divisions of the vernier, will be above the corresponding divisions of the limb respectively $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, &c.

If the vernier is placed in any other position, such as C B, we see that the zero point on it corresponds to 56 degrees and a fraction; this fraction expressed in tenths, is found, by observing that the sixth divisional line on the vernier is just on one of those of the arc; and hence the angle A B is 56° and 6 tenths.

In most instruments used to measure angles, the circle is divided into 360 degrees, and the vernier reads to minutes; the arc of the vernier being 59 degrees and divided into sixty equal parts. If the circle is divided into half degrees, the arc of the vernier is made 29 degrees and divided into 30 equal parts, and will give the thirtieth of a half degree, which is a minute. If we desire great precision in obtaining the parts of a minute, the circle and the vernier are divided into much smaller parts; but to do this, the instrument must be constructed with great care, and of large dimensions. If, for example, we wish to read to 5″, each degree of the limb is divided into twelve parts, each part occupying five minutes. Then take upon the vernier an arc of 59 of these parts and divide it into 60 equal parts, and the fraction will be $\frac{1}{60}$ of 5 minutes, or 5 seconds Repeating circles and theodolites are frequently divided with this minuteness; (see Nos. 92 and 105) but this precision is neither usual nor necessary in the ordinary surveying instruments.

Although the very small divisions of the limb and vernier of these

instruments, can only be read by the aid of a magnifying glass, the art of constructing them is carried to such perfection by the aid of machinery, that the equality of the divisions may be entirely relied upon. As it would be difficult to count the number of divisions on the vernier from the zero point to the division of coincidence, they are numbered at regular intervals of five or ten parts; the number expressing the minutes, or seconds, &c., as the case may be, to be added to the number of degrees marked on the limb, at the point indicated by the zero of the vernier.

An instrument well centered and well adjusted, gives results with astonishing accuracy.

When the vernier and limb are graduated into small divisions, it is frequently difficult to determine at which of two consecutive lines of division the coincidence occurs. In this case, the mean between them is taken.

10. *The Tangent Screw.*—This is an invention designed to communicate very slight motion to a piece which has a motion along another piece which is stationary.

If, for example, we wish to direct the telescope of a graphometer upon a signal, it is first directed very near the object. This being done, the purpose of the tangent screw is to place the object and the crossing of the hairs in exact coincidence.

The difficulty which this problem presents, consists in making the telescope independent of the tangent screw in its large movements, while in the small movements it shall be regulated by it. The following is a description of the manner in which this is done.

A B (fig. 16) is the limb of a graphometer; C D the arm, or movable radius which carries the telescope; D, a part of the arm, is a slider and carries along with it the screw V, which turns in a socket *b*. In an opening *a b* of the slider is lodged a piece of metal susceptible of being moved along in the open space for a short distance. This piece being attached to the arm C D, and the telescope, by means of the screw V, which acts as a connecting rod, carries with it a female screw *i*, in which the screw V bites; so that when this piece of metal is clamped to the limb and the screw V turned, the slider or arm D advances or recedes, and communicates a slight movement to the telescope with which it is connected. Under this fixture is a clamp with two springs, and provided with a clamp screw K. These springs release or hold fast the limb according to the direction in which the clamp screw is turned.

To use the tangent screw, loosen the clamp, and turn the arm C D, which carries with it the vernier, the tangent screw and the telescope, until the telescope is turned very nearly on the signal; then clamp the

piece of metal which carries the female screw *i*, to the limb by turning the clamp screw K. This done, turn the tangent screw V in the socket *b*. As this screw bites in the female screw *i*, which becomes fixed by clamping, it moves in either direction the slider or arm D, and imparts to the telescope a very delicate motion, by which the cross hairs in the diaphragm can be made to coincide with the signal.

The socket *b*, and the female screw *i*, are mounted on pivots, that the axis of the screw may always remain perpendicular to the arm C D, and that the screw may move freely by a slight touch.

One entire turn of the tangent screw moves the slider or arm along the female screw only a distance equal to one spiral, measured on the axis of the screw. If this distance is half a millemetre [.01968 of an inch] and the screw is turned thirty degrees, that is one-twelfth of an entire revolution, the arm will be moved only one twenty-fourth of a millemetre, [.00164 of an inch.]

The arrangements of the tangent screw vary with the form of the instrument, but are always according to the principles explained above. The vernier, instead of being placed in a rectangular opening at the termination of the arm, as in fig. 16, is more frequently placed at the side of it, as in fig. 9.

A magnifying glass M is attached to the arm, and revolves with it, for the purpose of reading the graduations on the limb and the vernier. It is furnished with a hinge at I to enable the operator to place it at the proper distance from the graduation to suit his vision.

11. *The Tripod.*—The stand which supports surveying instruments is called a tripod. It consists of three legs which can be so opened or closed as to allow the instrument to retain a horizontal position notwithstanding the inequalities of the ground. The legs forming the tripod are joined together by being screwed to projections from a metallic plate called a staff-head, which supports also the socket of the instrument. These staff-heads, and the arrangements for screwing the legs to them, are of various kinds. When the legs are thus secured at the top, and spread out at the bottom, a stand is formed sufficiently stable. The extremities of the legs are shod with iron. When the instrument is to be transported, the legs are removed from the staff-head, laid together, and bound by a movable band of iron.

The legs being light, sometimes yield in using the instrument.* To obviate this and give additional stability to the instrument, the legs should be made in the shape of a V, as in fig. 14.

12. *The Universal Joint.*—It is necessary that an instrument be

* This inconvenience can only occur to the most unskilful operator. The force of the wind is a more probable cause.

so joined to the stand that a horizontal, vertical, or oblique position, according to the nature of the observation, may be given to the limb. This junction is by means of the universal joint which admits of any of these positions for the instrument. There are various kinds.

The Ball and Socket.—This is composed of a short rod *i*, fixed to the instrument and terminated by a brass ball O (fig. 13.) The brass cylinder L N, which has at bottom a cavity to receive the staff-head, is terminated at top by two shells E E; these are two distinct pieces, concave towards each other, one of which is permanently fixed to the cylinder L N, while the other being free, can be brought in contact with, and pressed against, the first by means of the clamp screw M. By loosening the clamp screw, the ball can be moved in every direction, and the limb made to take any position desired. When the limb is in the desired plane nearly, the screw M is slightly turned, the friction being sufficient to retain the ball, at the same time that it will allow enough motion to place the limb exactly in position. This being done, the screw M is tightly clamped.

13. *Cugnot's Joint*, (fig. 19,) is composed of a nut N, formed of two cylinders whose axes are placed at right angles and one a little above the other. The bolts B′ B′, and B run in the direction of the axes, and are screw-tapped at one end to receive nuts.

When the joint is attached to the tongues L L, which carry the table of the instrument, we can by loosening the nut, move the table in two directions, perpendicular to each other, and consequently adjust it to a horizontal position. By tightening the nuts all motion ceases, and the table remains fixed in the given position. The movements given to the table by this means are precisely similar to those of *Cardan's suspension*, used in the mariner's compass and in chronometers, to preserve a horizontal position on board of vessels. Cugnot's joint is very frequently used in the plane table, an instrument which we shall notice hereafter.

14. *The Road or Slope Level Joint.*—This is a simple hinge which gives a vertical motion to a spirit level, and enables the operator to bring the bulb in the middle. As its motion is very abrupt, it cannot be used with any degree of accuracy without the aid of a tangent screw.

To be continued.

Statement of the performance of the Locomotive Engine, "Hichens & Harrison," built by Messrs. Baldwin, Vail & Hufty, for the Philadelphia and Reading Rail Road.

On February 9, 1841, the above engine hauled over the Philadelphia and Reading railroad, 54½ miles in length, from Reading to its

intersection with the Columbia railroad, a train of *one hundred and five* loaded burden cars, laden with 1318 barrels of flour, 870 kegs nails and spikes, 635 bushels grain, sixty-three tons of blooms and bar iron, twenty cords wood, eight casks oil, and sundry other articles of freight, amounting, in all, to $308\frac{1}{2}$ tons of 2240 lbs.

Weight of the 105 cars, 173 tons, making a total gross weight of $481\frac{1}{2}$ tons of 2240 lbs., equal to *one million seventy-eight thousand five hundred and sixty pounds*, hauled by the engine, not including her own, or her tender's weight.

Cars all four wheeled, wheels three feet diameter, lard and tallow only used in boxes. Whole length of train, 1260 feet, (or sixty feet less than one-fourth of a mile.) Running time, four hours fifty-four minutes, making an average speed of $11\frac{1}{10}$ miles per hour.

Total quantity of fuel consumed, 2.51 cords of oak wood.

Total quantity of water evaporated, 1804 gallons.

Oil used by engine and tender, seven quarts, including oiling before starting; longest continuous level over which the above train was hauled, $9\frac{1}{10}$ miles. Her speed, with the train on this level, $10\frac{9}{10}$ miles per hour.

Weight of engine, empty, 23,250 lbs. With water and fuel, 26,710 lbs. Weight on driving wheels, with water, fuel, and two men, 14,120 lbs. Cylinders, $12\frac{1}{2}$ by 16 inches stroke; driving wheels, four feet diameter.

The above road has no *ascending* grade, from Reading *towards* Philadelphia, with the exception of half a mile, at its lower terminus, or intersection with the Columbia railroad, graded at $26\frac{1}{2}$ feet per mile, on which grade the train was stopped.

The profile of the road, from Reading to this point, is divided into levels, varying from 1600 feet to $9\frac{1}{10}$ miles in length, and *descending* grades of from one and a half to nineteen feet per mile, the latter being the heaviest grade on the road.

Total length of level line between above points, $27\frac{8}{10}$ miles.

Total fall, from where the train was started to where it was stopped, near the Columbia rail road, 214 feet.

Shortest radius of curvature on the road, 819 feet; 1480 feet of curve struck with this radius.

The engine started the above train on a level, without any assistance, and gradually increased her speed to the average rate above mentioned.

She worked with great ease to herself during the whole trip; and hauled the train for the last fourteen miles, ten of which were level, over rails in very bad order, owing to a light snow storm, which moistened without wetting their surface; the effects of which, in di-

minishing the adhesion and power of the engine, practical engineers can well understand and appreciate.

The above performance is believed to be unsurpassed; and the train to be the longest and heaviest ever hauled by *one* engine on any railroad in Great Britain or America.

G. A. Nicolls,
Superintendent Trans. Phila. and Reading R. R.
Reading, Pa., Feb. 10th, 1841.

Second Report of the Directors of the New York and Erie Railroad Company, to the Stockholders. February 3rd, 1841.

[continued from page 265.]

Appendix.—Note A.

To E. Lord, Esq., President, &c.

Sir—The subjoined statistical tables, having a bearing on matter connected with the great work of internal improvements, in which you are engaged, I have prepared with much care, and respectfully submit the same for the consideration of the stockholders of your company, and the public. Your obedient servant,

Edwin Williams,
Compiler of the New York Annual Register.
New York, February 3rd, 1841.

1. *Annual consumption of country produce in the city of New York.*

The following is an approximate estimate of the annual amount of sales of articles of country produce, in the city of New York, for the consumption of the inhabitants.

Fresh Beef,	$ 1,470,000
" Veal,	365,000
" Mutton and Lamb,	335,000
" Pork,	600,000
" Poultry, Game, Eggs, &c.,	1,000,000
Salted Beef, Pork, and Hams,	1,200,000
Vegetables and Fruit,	1,200,000
Milk,	1,000,000
Butter, Cheese, and Lard,	1,500,000
Flour, Meal, and other Bread Stuffs,	3,000,000
Hay and Oats,	750,000
Fuel, (Wood and Coal) exclusive of Steamboat Fuel,	2,500,000
Articles not enumerated,	580,000
	$ 15,500,000

The above is not intended to include building materials.

The opening of a new avenue for supplying our markets, such as the New York and Erie railroad, which passes through a section of country well adapted to the furnishing of most of the above articles, would doubtless have the effect of reducing prices by increasing the abundance of supplies. This reduction may be safely estimated to

average ten per cent. on the above amount, thus saving, annually, to the inhabitants of this city, a million and a half of dollars.

2. *Increase of population, &c., in the Railroad Counties.*

Increase of population and wealth in the counties traversed by the New York and Erie railroad, and of adjacent counties and parts of counties in this State, as shown by the census of 1830 and 1840, and the taxed valuation of real and personal estate in the same years:—

Counties traversed.	*Census.* 1830.	*Census.* 1840.	*Value of real and personal estate.* 1830.	*Value of real and personal estate.* 1840.
Rockland,	9,388	11,874	$1,696,790	$2,229,469
Three-fourths of Orange,	34,029	38,050	6,325,777	8,656,670
Sullivan,	12,372	15,630	1,215,750	1,319,586
Three-fourths of Delaware,	24,700	26,522	2,315,555	2,544,060
Broome,	17,582	22,348	1,785,168	2,361,737
Tioga,	27,704 (Tioga and Chemung)	20,350	2,398,002 (Tioga and Chemung)	1,906,747
Chemung,		20,731		3,015,592
Steuben,	33,975	45,992	1,476,340	5,787,282
Alleghany,	26,218	40,920	1,260,442	5,216,000
Cattaraugus,	16,726	28,803	1,249,018	4,149,073
Chatauque,	34,657	47,641	1,851,353	4,360,179
Counties Adjacent.				
Two-thirds of Oswego,	34,248	32,942	3,588,730	3,879,397
Chenango,	37,404	40,779	3,481,314	4,293,438
Cortland,	23,693	24,605	2,169,119	2,320,720
Tompkins,	36,545	38,113	2,726,596	4,360,673
One-third of Cayuga,	15,982	16,787	1,384,711	4,170,885
One-third of Seneca,	7,010	8,289	1,008,043	1,726,318
One-half of Yates,	9,504	10,221	1,020,348	3,231,091
One-fourth of Ontario,	10,042	10,875	1,945,088	3,464,312
One-half of Livingston,	13,859	17,855	1,712,366	5,072,979
One-half of Genesee,	25,996	29,820	2,149,297	6,462,772
One-fourth of Erie,	8,928	15,538	724,781	3,471,378
	460,562	564,685	43,484,588	84,000,358
		460,562		43,484,588
Increase in ten years,		104,123		$40,515,770

3. TABLES SHOWING THE EFFECT OF INTERNAL IMPROVEMENTS ON THE VALUE OF PROPERTY IN THE CITY OF NEW YORK.

1. *Chronological Table of the Assessed Value of Real and Personal Estate in the city of New York, during three Commercial Periods.*

1*st Period*—From the close of the last war with Great Britain to the completion of the Erie canal:

Year.	*Assessed Valuation.*	*Year.*	*Assessed Valuation.*
1815,	$81,636,042	1820,	$69,539,753
1816,	82,074,200	1821,	68,285,070
1817,	78,895,735	1822,	71,289,144
1818,	80,245,091	1823,	70,940,820
1819,	79,113,061	1824,	83,075,676

2d Period—From the opening of the Erie canal, in 1825, to the completion of the Ohio canal:

1825,	$101,160,046	1829,	$112,526,016
1826,	107,477,781	1830,	125,288,518
1827,	112,211,926	1831,	139,280,214
1828,	114,019,533	1832,	146,302,618

3d Period—From the completion of the Ohio canal, in 1832, to the present time:

1833,	$166,495,187	1837,	$263,747,350
1834,	186,548,511	1838,	264,152,941
1835,	218,723,703	1839,	266,882,430
1836,	309,500,920	1840,	252,135,515

N. B. During the latter period, namely, since 1832, about 470 miles of railroad have been completed and put in operation in this State, besides about 2,500 miles of railroads in other States. Thus it will appear that since the introduction of the *railroad system*, the value of real and personal property in the city of New York has increased over *one hundred millions of dollars.*

The amount of tonnage of canal boats passing and repassing Utica, on the Erie canal, for one year, it is ascertained, is greater than that of all the foreign and domestic shipping entering and clearing at the port of New York. (*See R. R. J. Vol.* 4, *No.* 1.)

2. *Chronological Table of the Assessed Value of Real Estate only, in the city of New York, for a series of years:*

Year.	*Real Estate.*
1817,	$57,799,435
1820,	52,062,858
1823,	50,184,229
1825,	58,425,395
1828,	77,139,880
1831,	95,716,485
1833,	114,124,566
1834,	123,249,280
1836,	233,742,303
1839,	196,940,134
1840,	187,121,714

Increase of value of real estate in this city, since 1831, over ninety-one millions of dollars.

Assessed value of personal estate in 1840,	$65,013,801
" " " 1833,	52,366,976
Increase,	$12,646,825

Extract from a report to the stockholders of the Camden and Am boy Railroad Company, dated January 29th, 1840:—

"Two years since, at the request of some market people in Ne Jersey, a line called the Pea Line, with two cars, was occasionall started from Camden to New York, with no other view or expecta tion than the accommodation of a very useful and respectable clas of men. This line has steadily increased, until it has become profi able beyond all expectation. During the past year, it has been run ning daily, sometimes taking with it as many as sixteen cars, lade at the appropriate season, with peas, peaches, potatoes, asparagu cabbages, live stock; and upon one occasion, (incredible as it ma seem) thirty tons of green corn. This, connected with the gradua increase on the other lines, will enable you to judge what you ma fairly expect in a few years hence; always bearing in mind, that th expenses do not increase in the same ratio with the receipts, becaus the same capital can do a larger business, whilst the interest to b paid remains the same."

(Note B.)—Dunkirk Harbour.

Extract from the documents accompanying the President's Mes sage to Congress, of December, 1837.

"The importance of the harbour of Dunkirk, in a commercial poin of view, has heretofore been fully set forth. The surface enclosed by the government works, will be about two hundred and eighty acres, of which there are eighty acres of excellent anchorage, wit clay bottom; and there is wharf room sufficient for the transaction o a very large business. It occupies a position nearly midway betwee Buffalo and Erie. It is extremely valuable as a port of refuge, and has been much resorted to for that purpose by steamboats and sai vessels; and it has been selected for the termination of the New York and Erie railroad through the southern tier of counties of the State of New York; a work, the completion of which will at once place i among the chief harbours on the shores of lake Erie. The numbe of steamboats and sail vessels touching at this port has, during the past season, greatly increased. From the opening of the navigation on the 5th May, to the 30th September, 1837, the number of arrivals of steamboats was 630, whose probable tonnage amounted to 183,177 tons, and the number of passengers to 78,700. During the same period, the number of arrivals of sloops and schooners was 103. Shipping to the amount of 778 tons is owned at the port."

The above is taken from the annual report of T. S. Brown, *General Superintendent of the United States works at the east end of lake Erie.*

The distance from Dunkirk to Piermont, on the Hudson river, by the line of the New York and Erie railroad, is 446 miles. Including the *ferry,* the whole distance to New York city does not exceed 468 miles.

From Buffalo, by the way of Albany, to New York, the distance by railroad will be about the same, viz:—

Buffalo and Batavia railroad, (via Attica,)	39	miles.
Batavia and Rochester "	32	"
Rochester and Auburn "	78	"
Auburn and Syracuse "	26	"
Syracuse and Utica "	54	"
Utica and Schenectady "	78	"
Schenectady and Albany "	16	"
Albany and New York "	149	"
Total,	472	miles.

Dunkirk is forty-two miles west of Buffalo, on the south shore of lake Erie, and its harbour is occasionally open many days, and even weeks, earlier in the spring and later in the fall.

The line of the New York and Erie railroad being entirely in the hands of one company, the principle of charging less per mile in proportion as the distance traveled is greater, may be brought into action, and will, doubtless, result in great advantage both to the public and to the company. Passengers from Dunkirk to New York city, for instance, may be charged twelve dollars, which will be about two and a half cents per mile; whereas, way passengers traveling 100 miles or less, may be charged four cents per mile. As the superstructure will be heavy and substantial, passengers by quick trains may with certainty and safety go from Dunkirk to New York in from twenty to twenty-four hours, or at the average speed of twenty miles an hour, including stops.

If we compare this with the state of things at present existing on the northern line, and which will probably continue for a considerable time to come, we shall see that there, in consequence of there being eight different corporations, each of which, until compelled by some strong inducement to the contrary, will charge the full rate of four cents per mile, the price of the passage from Buffalo to New York will be from seventeen to nineteen dollars,—the former sum allowing for a deduction by the competition of the North river steamboats. As the track on the northern line consists of the light plate bar, the speed cannot exceed fifteen miles per hour; and the time occupied, including the unavoidable detentions resulting from so many different proprietorships, the ferry at Albany, etc., cannot be less than thirty-six hours. The New York and Erie railroad, therefore, at the first commencement of its operations, may very well be able to offer to passengers from lake Erie and the western States, the inducement of a saving of $5 in expense, and twelve hours in time.

The following statements, which exhibit in a very striking manner the rapid increase of the trade of the upper lakes, are extracted from a late report of Lieut. Col. Kearney, *of the United States Topographical Engineers.*

"In the year 1825, there was but one steamboat, of 350 tons bur-

den, and thirty or forty small craft on the American side of the upper lakes, and the tonnage was, in all, somewhere about 2,500 tons. In the year 1830, the registered and enrolled tonnage was yet but 3,497 tons, and the canals which connect the trade with the St. Lawrence and with the Hudson, had been completed.

"In 1831, when the works on lake Erie had begun to afford some protection to vessels, the tonnage employed upon it had nearly doubled that of the preceding year. There were now eleven steamboats and one hundred other vessels, the aggregate tonnage of all amounting to 6,532 tons.

"In 1832, the Ohio canal, connecting the lake trade with the valley of the Mississippi, was completed. The aggregate licensed and enrolled tonnage, according to the treasury statements, (we have no other account of the shipping for that year,) was 8,552 tons. During this and the succeeding year, the harbours, as already stated, were becoming at all times accessible to the largest class of vessels, and in the latter year (1833) this accessibility was effected. In that year the aggregate tonnage was 10,471 tons. Since that time it has continued to be steadily progressive to the present period. We have more precise accounts of it for the years 1836, 1837, 1838 and 1839, and we insert here the aggregate tonnage for these four years, distinguishing between that of steamboats and rigged vessels:—

"In 1836, there were 45 steamboats, (9,017 tons,) and 211 vessels, (15,030 tons) in all, 24,047 tons.

In 1837, there were 50 steamboats, (10,509 tons,) and 230 vessels, (16,934 tons,) in all, 27,443 tons.

"In 1838, there were 52 steamboats, (17,429 tons,) and 234 vessels, (16,848 tons,) in all, 34,277 tons.

"In 1839, there were 61 steamboats, (17,324 tons,) and 225 vessels, (17,799 tons,) in all, 35,123 tons.

"The value of the shipping of all classes in the year 1839, is $2,400,600, and they furnish employment for two or three thousand persons. In the year 1836, it was estimated that the capital invested in steamboats was $1,000,000. In the year 1839, the cost of steamboats is estimated at $1,741,200. In the year 1837, it was estimated that, taking into view the average number of trips made by each class of vessels, the trade per month, during the business season, amounted to 75,898 tons. Following this rule, and applying it to the year 1839, we would have about one hundred thousand tons as the monthly business."

(Note C.) *Description of the manner in which it is proposed to construct the track of the New York and Erie railroad, on those portions not already laid. The part between Goshen and Piermont has been made on the same principles, with some modification of the details.*

The iron rails are of the H form, with heavy heads. They are three and a half inches high, four inches wide on the base, and weigh fifty-six pounds per lineal yard. Both sides are alike, in order to ad-

mit of reversion, if symptoms of failure are perceived in those parts exposed to the action of the wheels.

The rails are to be supported on continuous bearings of timber, twelve inches broad, eight inches thick, and as long as can be conveniently obtained. They must be scarphed at the ends, so that no irregular elevation or depression of either stick can take place at a joint. They will break joints with each other, and with the iron rails; and will be bound together, at every six feet on curves, and at every eight feet on tangents, by cross ties of plank, seven and a half feet long, three inches thick, and seven inches wide, fitted accurately into notches two and a half inches deep, on the upper side of the longitudinal timbers, and secured by a treenail, or pin of oak, two inches in diameter. The position of the base of the rail having been then accurately marked out on the cross ties, notches half an inch deep and four inches wide will be cut in them, so as to let the rail rest continuously on the longitudinal timbers, the edges of which must be addiced down to shed the rain.

The rails are secured from any motion, except that due to the expansion and contraction of the metal, by appropriate chairs of cast iron at the joints; and are fastened to the timbers by brad headed spikes, half an inch square and five and a half inches long, one of which is required for every eighteen inches.

Where timber of suitable quality is found on the line of the road, it may be hewn on two sides instead of being sawed square. In such cases it must be got out nine inches thick, and counter hewn on the upper surface before being laid.

It will be noticed that by this plan of road, each bearing timber rests continuously on the ground, and at the same time supports continuously the iron rail. The cross ties too, have a double action; binding together the longitudinal bearers, and also connecting the rails, by the notches into which their bases are fitted. By placing the ties on the upper side of the bearers instead of the lower, the connexion is made at the point where its efficiency is greatest and most necessary, and as no part of the vertical support is derived from the ties, the dimensions proposed for them will be found sufficient.

The drainage of the track will be effected by a ditch between the longitudinal timbers, for which the width between the rails affords ample room; and cross drains at suitable distances will carry off the water. The centre drain, will be sunk lower than the cross ties, so as not to interfere with them.

The following extract from an English writer, Mr. John Reynolds, explains very satisfactorily the disadvantages of the ordinary modes of constructing railways, and accounts, in some measure, for the great weight which the latest patterns of British rails exhibit.

"The principle of continuous bearings, avoids the chief obstacle to durability, which pertains to the plan of supports at intervals, whether they be blocks or sleepers, viz. the alternation of *flexible spaces* and *rigid points*, which, (even if the supports maintain an exact level,) produces in carriages moving rapidly over them, a series of concussions, as the wheels successively impinge on the rigid or sup-

ported parts of the rails. Also, however small may be the deflexion of the rail between its points of support, those points become fulcra, on which it acts as a lever, to raise or shake the supports next beyond them. When the supports assume irregular heights, (which is the usual case,) not only are the above evils greatly aggravated, but the rail acts upon every support as a spring beam, tending to jerk it up, or loosen its fastenings."

Where a *piled road* is adopted, (which will be the case on more than two hundred miles of the Susquehanna and Western Divisions,) a similar superstructure is proposed, with the necessary modifications for connecting it firmly and securely to the heads of the piles.

The *width of track* on the New York and Erie rail road is six feet, and the distance between the tracks (where two lines are laid,) is seven feet. These dimensions admit of wider and more commodious cars being used with safety, than can be adopted for roads of the ordinary width. The first class passenger cars already built for this road, are believed to be equal to any hitherto constructed in the United States, with regard to beauty and finish, and superior in all the arrangements and appliances requisite for comfort and ease. They are eleven feet wide, and thirty-six feet long, and are mounted on eight wheels. Those intended for gentlemen, will accommodate, comfortably, seventy-eight persons. The ladies' cars have drawing and retiring rooms of ample dimensions.

The second class cars, intended for the use of emigrants, and others desirous of traveling at a low rate, and willing to accept of cheaper accommodations, will be capable of carrying one hundred persons.

[TO BE CONTINUED.]

Bibliographical Notice.

Notice of a description and catalogue of the Derby Arboretum. By J. C. Louden, F. L. S., &c. &c.

A garden comprising eleven acres of ground, beautifully laid out and embellished with upwards of a thousand different varieties of plants and trees, has lately been presented to the inhabitants of Derby, England, by one of their citizens, Joseph Strutt, Esq., as a place for public recreation. The admirable design of this garden, both for physical and intellectual enjoyment, as well as for general improvement in the interesting science of botany, is worthy of particular remark, and may afford useful hints in the laying out of Public Grounds in any country.

It consists of a collection of such trees and shrubs, foreign and indigenous as will endure the open air in the climate of Derby, with the names placed on each.—The author of the plan, J. C. Louden, Esq., observes, in reference to it, "that such a collection has all the beauties of a pleasure ground viewed as a whole; and yet, from no tree or

shrub occurring twice in the whole collection, and from the name of every tree and shrub being placed against it, an inducement is held out for those who walk in the garden to take an interest in the name and history of each species, its uses in this country and in other countries, its appearances at different seasons of the year, and the various associations connected with it."

In order to excite an interest in the subject, visitors are supplied with printed catalogues containing the names of the plants, their habits, native localities, &c. "The order in which they are arranged," continues Mr. Louden, "is what is called the *natural method*, by which plants are classed or grouped according to the greatest number of points in which they resemble one another. The largest groups form classes, the next largest orders, and these are subdivided into tribes, genera, species, and varieties. This mode of bringing plants together in groups greatly assists, not only the memory, but the judgment; for, if we recollect any one plant in a group, and its properties, we may conclude that all the others belonging to it bear the same general resemblance externally, and contain, more or less, the same internal properties. This any visiter of the garden may convince himself of by looking at all the plants enumerated under any one order, and comparing them with one another; and this he may do at any season of the year, though to the greatest advantage when the plant is in flower."

The gravel walks in the garden measure upwards of a mile in length and are ornamented with pedestals, vases, seats for three hundred and fifty persons, beautiful pavilions in the style of James the first, and lodges in the Tudor and Elizabethan style.

The plan of the Arboretum emanated from the highly cultivated mind of Mr. Louden, its execution was attended to by him in person, assisted by Mr. Rauch, and the architectural designs for the pavilions and lodges are by Mr. Lamb, of London. The best talent of the country has thus been brought into requisition by Mr. Strutt to give value and elegance to his gift.

Instances of *living* munificence on so grand a scale as this are seldom to be found. Men frequently *leave* their accumulations of wealth to public objects, and give, for noble purposes, treasures they can no longer enjoy nor take with them; but however praiseworthy such posthumous generosity may be, it bears no comparison with the liberality of the man who shares his fortune with a whole community during his life-time, and thus deprives himself of what he might probably live long to enjoy.

A pamphlet containing a description of the Arboretum, a catalogue of the trees and plants, and an account of the ceremonies of opening

it to the public, has been received from the author, and is placed in the Library of the Institute. T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1840.

With Remarks and Exemplifications by the Editor.

1. For an improved machine for *Pressing Palm-leaf Hats;* Chester Gorham, Barre, Massachusetts, March 3.

In this machine the hat to be pressed is placed on a block attached to the upper end of a vertical shaft, the lower gudgeon, or pivot, of which rests on a sliding step provided with a weighted lever for the purpose of forcing the crown and rim of the hat against the irons. The irons, or, as they are termed, "boxes," in which the heaters are placed, are attached to a sliding frame provided with a lever to enable the operator to apply them to the hat and draw them off. One of the "boxes" is attached to each side of the frame for the rim, a third is attached by gudgeons to the back, for the crown, and the fourth slides in a vertical frame rising from the first mentioned frame, to press the top of the crown, and is furnished with a screw to regulate its distance from those that press the rim. The weighted lever is provided with a catch to relieve the pressure. The claim is confined to the combination of the boxes that press the rim and crown attached to the first mentioned frame, the box that presses the top of the crown regulated by a screw, and the shaft to which the hat block is attached. Some practical difficulties present themselves in the carrying out of the alleged improvements, as for instance, the irons which press the rim are both attached unyieldingly to the sliding frame, hence they cannot accommodate themselves to the inequalities of the hat—so of the pressure applied to the top of the crown, the distance between the top and the two rim irons, is regulated by a screw, which when set will not yield to inequalities. These difficulties do not exist in the machine previously known, in which the irons are attached by a universal joint to a lever, and the pressure applied to the hat by the operator's hands.

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2. For an improvement in the manner of constructing *Bedsteads;* John Hart, Lebanon, Kentucky, March 3.

This improvement consists simply in extending the shoulder of the rail, which fits against the post, considerably beyond the periphery of the rail so as to render the posts more steady. "What I claim as my invention and desire to secure by letters patent, is the extension of the shoulder beyond the periphery of the rail in the manner and for the purpose specified."

3. For improvements in *Fire Escapes;* Sylvester Pentfield, Hartford, Connecticut, March 3.

This fire escape consists of a vertical shaft, rising from a pedestal of peculiar construction, on which slides a platform which can be moved up and down by the persons on it by means of a pinion mashing into a rack on the shaft. The platform is provided with a railing except on the side to be presented to the fire where it is provided with polished plates of metal which slide in grooves, to serve as a protection against the flames. The pedestal is formed of four bars called "arms," each of which is jointed to the lower end of the shaft, thus forming a cross. There are four diagonal braces hinged or jointed to the shaft, the lower end united to the outer end of the "arms," by attaching the end of each brace to a "block," which slides in a "mortice in each arm," and regulated by a screw. It will thus be seen that the shaft can be maintained in a vertical position without reference to the inequalities of the ground. The outer end of each arm is provided with a truck roller to facilitate the moving of the machine.

The claims are, "1st, combining with the movable platform, plates of polished metal, or of wood and metal combined, the said plates sliding in grooves at the back of the platform. And 2nd, the mode of keeping the shaft in a vertical position, so as to adapt it to any inequality of soil by means of the following combined arrangements, viz. the arms hinged to the shaft so as to admit of their being raised or lowered, in combination with the braces attached to the block moving in a mortise in the aforesaid arms, and regulated by means of a screw."

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4. For an improvement in *Dry Docks;* Charles F. Johnson, Tioga, New York, March 6.

This dock operates on the principle of those which raise the vessel by having inverted boxes under the cradle, into which air is introduced to exclude the water, and the patent is granted for a mode of preserving the equilibrium of the cradle and prevent rocking, which is effected either by means of vertical screws attached to each side of the cradle and passing through nuts on each side of the dock, or by racks with ratchets into which palls work, or by ropes passing around pullies attached to the sides of the cradle and dock.

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5. For an improvement in the *Door Latch;* Benjamin M. Bosworth, Warren, Rhode Island, March 6.

This improvement consists in the manner of working the latch by means of a rod of iron which passes through a vertical slot in the door, and which is provided with a knob on each side; when the rod is lifted up, it comes in contact with the inner end of the latch, which it lifts, and thus depresses the outer end, and disengages it from the hasp —the latch being the reverse of the common latch in its operation. The claim is confined to the mode of disengaging the latch by raising the rod and knobs vertically in the slot.

6. For an improvement in the *Knob Latch* for doors, &c.; Lewis and Willis Hotchkiss, Derby, Connecticut, March 6.

This improvement is applicable to the lifting and to the sliding latch, and consists simply in dispensing with the "lever," or "cam," usually employed on the bar to give motion to the latch, and effecting the same thing by cutting a notch in that part of the bar which comes in contact with the lever little less than one-half of its diameter, leaving a flat face which forms the cam. The amount of motion to be given to the latch will depend upon the diameter of the bar and the depth of the notch, which should not be more than the semi-diameter of the bar. The claim is confined to this device.

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7. For an improvement in the machine for *Mixing and conveying Clay for Making Bricks;* James Hodge, Fairplay, South Carolina, March 6.

A large threaded screw revolves in a trough for the purpose of mixing and conveying the clay to the moulding machine. At one end of the trunk there is a hopper in which work two pounders by means of tappets on a shaft, for the purpose of breaking the large lumps of clay, and forcing it into the threads of the screw, and at the opposite end of the trunk the clay is discharged into the moulds and pressed. The claim is confined to the pounders, or rams, in combination with the screw for mixing and conveying clay.

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8. For a *Machine for Colouring Maps, Charts, or other Prints;* Lucius Stebbins, Hartford, Connecticut, March 12.

The map or print is attached to a table so that it shall not move during the operation of colouring. A plate revolves upon a pin, or axis, attached to the same table, and to its outer edge are secured, in succession, a series of thin metal plates with holes through them corresponding with the boundaries of countries, &c., which are to be differently coloured. These plates are in succession applied to the surface of the map, &c., and the colour applied as in the process of painting with theorems. The patentee says, "I do not claim the invention of colouring through patterns or theorems as they are sometimes called; but I do claim as my invention and desire to secure by letters patent, attaching the patterns to a plate revolving on a fixed centre, as herein set forth, and the combination of the revolving plate with the table on which the map is placed, the whole constructed and operating as above described."

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9. For an improvement in *Trusses for Hernia, &c.;* Enoch Thomas, New Athens, Ohio, March 12.

This truss consists of an elastic belt passing around the body, to which the hernial, sacrum, and ilium pads are attached. From the sacrum pad two straps descend to the perineal pad, and from it the round straps pass and are connected to the front or hernial pads. Two pads, called femoral pads, one of which is straped around each

thigh, and connected to the belt by means of two straps attached to each and buckled on to the ilium and front pads. The patentee says, "this new and useful improvement is especially designed and perfectly adopted to cases of inguinal hernia, either in the male or female, and is so constructed as to prevent, during its application, any protrusion of the intestines through the inguinal ring. It is also perfectly adopted to cases of prolapsus uteri in females. What I claim in the elastic and spring supporter as my invention, is the simple combination of the thigh straps for retaining the belt in situ with the belt, constructed and operating as above described."

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10. For an improved mode of *Constructing Cars for Railroads and guiding them thereon;* Isaac Newton Stanley, Philadelphia, Pennsylvania, March 12.

It would be useless to attempt to give, without drawings, more than a general idea of the construction of the cars by which they are made to follow the curvature of the road and to run in and out without the aid of switches or any attendance. The improved construction is adapted to the eight wheeled cars now in general use, but instead of having the two axles of each truck in one frame, each axle is in a separate frame, and two of these frames are united together to constitute a truck, so that each axle can be thrown into the radii of the curvature, and the two trucks are so connected that when the axles in one truck assume the direction of the radii, those in the other truck are compelled to do the same. Instead of placing the outer rail of a curve upon a higher level than the inner one, to prevent the centrifugal force from throwing off the cars, this object is attained by a contrivance which gives to the body of the car an inclination inwards the moment the first truck runs upon a curve and assumes the line of the radii.

A guide rail is employed to prevent the cars from running off the track in short curves, and to compel them to follow any given track by having a roller connected with the car, and acted upon by the guide rail in a manner which could not be clearly explained without drawings. The patentee concludes by saying "I claim the manner in which I construct and combine the two four wheeled trucks as above set forth, by which the axles are made simultaneously to conform themselves to the radii of the curvature of the track; that is to say, the manner in which I connect the parts which I have denominated the hounds, with the respective frames of the trucks, and with the general frame or car bed, so that the two studs, or slides, which work in the slotted metallic plates, and the two transoms, or king bolts, always standing in a right line shall compel the respective angles to conform themselves to the curvature of the road by an arrangement of parts substantially as above set forth. I claim the manner of causing the load to incline over towards the inner rail of a curve by means of the projections below the bolster operated upon by the hounds, or by any analogous arrangement, as described. I claim the manner of compelling the locomotive or carriage to keep the proper

track by the aid of guard or guide rails constructed and located as herein described, and operating upon a guard or guide apparatus substantially with that herein made known, for the purpose of dispensing with switches and other analogous devices, and rendering the passing of the train, upon the proper track, independent of the engineer or conductor thereof. I also claim the use of the guard rail and guard apparatus for preventing the running of the carriage from the track, as described."

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11. For an improvement in the *Anvil for Heading Spikes;* Wm. Thomas, Hingham, Massachusetts, March 14.

A square hole is made vertically into the anvil for the reception of a block and tube of steel, the former resting upon the bottom of the hole in the anvil and the latter upon it. The hole in the tube is to receive the spike to be headed, and at the bottom there is a lateral groove which communicates with a groove running along the side of the block from top to bottom, for the purpose of discharging the oxides formed through a lateral opening in the side of the anvil. The usual heading tool is used. The claim is to "the making of an anvil with the openings at the top and side to receive the block and tube and for the escape of the oxides."

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12. For a mode of *Laying Veneers;* Casper Kittenger, Massilon, Ohio, March 14.

A board of any given length and width, to be governed by the size of the article to be veneered, passes through mortices made in two pieces of hard wood, one placed at each end. A mortice or slot is made in each of these pieces of wood, parallel with the one through which the board passes, to receive two rods of iron having a screw and nut on each end, to prevent them from falling out of the slot, but not screwed tight enough to prevent them from sliding along the length of the slots. To these rods is attached a band or sheet of iron, leather or cloth, reaching nearly the whole length, and hanging loose from one to the other, so as to form about a half cylinder. The board is provided with any given number of band screws, which pass through it and act upon the back of the article veneered, thus forcing the veneered surface against the band which adapts itself to the form of said surface. The claim is to the combination of the screws and bands, as described.

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13. For a *Cooking Range;* Herbert H. Stimpson, Boston, Massachusetts, March 14.

This range is provided with two side flues, built in the masonry, and inclining inwards until they unite with the main flue above the mantle; at the bottom they are immediately back of the side boiler holes, so that the draft can be carried from each side of the fire-place under the side boilers. The range is also provided with a hollow column on each side, and these are united at top by a hollow mantel. The main improvement consists in a particular arrangement of damp-

ers and flues, by which the draft can be carried either directly into the side flues in the masonry, or up the front half of the side columns, and thence along the front to about the middle of the mantel, the draft is then returned along the back of the mantel, and down the rear half of the columns into the side flues. For this purpose, the mantel is divided by a partition across the middle, and by two plates running from each end to near the middle, into two double flues, and each column is also divided by a partition plate into a front and back flue. The damper consists of a plate which slides under the bottom of the column, (one for each,) and to the bottom of it is attached another plate at right angles with it, so that they move together, and thus enable the attendant to give the proper direction to the draft. If it is desired to heat the apartment, the draft is carried through the columns and mantel, and then into the side flues, but if the heat is wanted for cooking only, it is then carried directly into the side flues. The claim is confined to the construction of the dampers, as described, and to their combination with the side flues in the masonry, and with the double flues in the columns and mantel.

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14. For a machine for *Breaking Dough;* John W. Post, Baltimore, Maryland, March 14.

This is alleged to be an improvement on the old machine for breaking dough, by means of two cylinders, through which the dough is rolled; the improvement consists in the method of returning the dough to the cylinders to be again rolled, instead of replacing it by hand, as in the old way. One of the cylinders, and that the upper one, if they are placed one above the other, is nearly surrounded by small rollers revolving in a direction the reverse of that of the cylinder. The space between the cylinder and the rollers is equal to that between the cylinders, so that the dough is carried up by them and presented again to the cylinder to be re-rolled. There are knives or scrapers placed between the rollers to prevent the dough from being carried between them. The patentee says that the same thing can be effected by means of a belt and one roller, and a weighted tightening pulley to yield when the dough passes between the cylinder and the belt. The claim is to the "manner of carrying up the dough after it has passed through between the breaking cylinders, by means of the elevating rollers, or by means of the rollers and belts united, to feed the breaking cylinders."

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15. For an improved *Sluice Gate for Canal Locks,* and which is applicable to other purposes; George W. Hildreth, Lockport, N. Y., March 19.

The claim upon which this patent has been granted, will give as distinct an idea of the principle of this improvement as could be given in a short description of it without drawings—it is in the following words, viz. "What I claim as my invention, and desire to secure by letters patent is, "1st. The making of the gate in the segment of a cylinder revolving on a pivot at each end, and fitting against concen-

tric plates attached to the frame in which the gate moves, as herein described." 2nd. "I claim the placing of the pivots of the segment gate below the centre of the circle, (of which the segment gate is a part,) so that in closing the gate a close joint shall be formed, and by the same means a greater pressure of water is brought upon the gate above the pivots than below, which assists in opening the gate, as described." 3rd. "I also claim as a substitute for the preceding, the placing the pivots of the segment gate in the centre, and placing the plates against which the gate slides, a little eccentric thereto, for the same purpose."

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16. For improvements in the *Floating Dry Dock* for raising vessels; Joseph T. Martin, New York, March 19.

This is an improvement on that kind of floating dock described in the 14th vol. of this journal, page 252, and in the 22nd vol., page 239, December 20, 1837. The ends of the main trunks, or floats, have appended to them separate hollow floats, which slide up and down, in frames constructed for that purpose, in the ends of the trunks, and they are retained in their position by racks and palls, and provided with pumps to let in or take out water. The sections of the dock, or the trunks, are united together by beams passing through slides, which are governed by a series of levers, in such a manner as that the dock can be shortened or lengthened whilst under water, by removing the trunks farther apart, or drawing them closer together. In the trunks there are water cisterns provided with pumps, and these are united by pipes with the body of the trunk, so that if desired, any water which may have leaked into them, may be pumped out by the pumps used to discharge the water from the cisterns. The claim is in the following words, viz. "I do not claim as my invention the formation of a floating dry dock by the union of sections or floating platforms, nor do I claim as my invention the construction and use of end floats, or any of the separate parts of the above described floating dry dock. But the end floats heretofore in use, have had no machinery attached to them by which they might be filled with water when necessary, for the purpose of causing to sink, or aiding to sink, the floating dock, and have, in fact, been so constructed with the intention that no water should ever be admitted within them, and therefore I do claim as my invention the new and useful improvement herein before fully described, or any other method substantially the same, by which they are filled with water and emptied of the same, for the purpose herein set forth. In combination with this I do claim the application of racks and palls for securing the position of the end floats, as herein set forth. I do also claim the above described combination of machinery by which the dock is lengthened or shortened whilst the dock is under water. And moreover, I do claim the application of the cisterns within the main floats, ("or trunks,") with their appendages, in combination with the reservoirs whereby the same pumps that are used for filling the reservoirs, may pump out the leakage of the main floats."

17. For an improvement in the mode of *Packing Rotary Steam Engines;* John D. Akin, Columbus, Pennsylvania, March 19.

This improvement is only for the packing of those parts which present two or three faces. The part to be packed is provided with a groove, into which the metallic packing is fitted. This packing consists of two metallic plates put together by halving the pieces where they meet, in the manner of a square shouldered splice, and two screws, with conical ends, are employed to spread and force out the two halves, the conical end of each screw passing in between the end of one piece and the shoulder of the other; so that as the screws are advanced the packing will be forced out and spread endwise. This kind of packing is described as applied to the steam heads and sliding valves of a rotary steam engine. The claim is to the mode of packing "by means of the countersink, halved plates, and conical screws."

Perhaps this may prove to be an improvement in the manner of packing, and so far so good, but the difficulties in the action of the rotary steam engine will be but very partially removed by an improvement in the manner of packing only.

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18. For an improvement in the *Cooking Stove*, designed for burning coal; Reuben Jackson, Zanesville, Ohio, March 19.

This stove is provided with two fire chambers, one at each end, there being a separate flue and outlet into the chimney from each; the oven is placed between the two fire chambers. The bottom of each grate is below the bottom of the oven; one grate being lower than the other. The draught from the highest grate passes up along one end, over the top of the oven, and out at the side; and up from the other grate, over a plate which separates the grate from the oven plate, down the back, along the bottom, and out at the side into the chimney. The claim is to the arrangement of the oven between the two fire-places, so as to carry the draught in the manner described.

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19. For an improvement in the manner of covering *Spring Saddles;* Orren M'Cluer, Fredonia, New York, March 25.

The leather of the saddle seat, instead of being attached to the head of the tree, is attached to a spring which is fixed to the head of the tree, or to the straining web, which connects the spring and the back of the saddle. The skirts of the saddle lap over the covering of the seat sufficiently to allow the play of the spring, without allowing the edge of the covering of the seat to be drawn from under them. This arrangement allows full play to the spring without straining the covering of the seat. The claim is confined to this mode of constructing, or covering, saddles.

20. For a mode of *Stretching Cloth in the process of Fulling;* B. D. Whitney, and G. W. Lawton, Winchendon, Massachusetts, March 25.

The cloth is carried around a series of rollers, one of which has its surface cut into a right and left-handed screw, each commencing in the middle and running out to the end. As this roller or double screw revolves with the cloth drawn over it, it will stretch the cloth widthwise. The same object is more effectually attained by making the surface of the roller in sections, sliding from the middle towards each end; the surface being seared or grooved so as to take hold of the cloth. The sections or segments project at each end beyond the body of the roller, and the part which projects is provided with a roller which fits into a spiral groove in a stationary cylindrical block at each end, and the grooves are so arranged that as the segments move around when they come to that part of their circuit in which they meet the cloth, (which is only in contact with a portion of the circumference,) the segments move outwards, stretching the cloth from the middle towards each edge, and when they leave the cloth they are drawn in. The claim is in the following words, viz. "We claim stretching the cloth widthwise during the process of fulling, or after it is fulled and steamed, by means of the right and left threaded screws, or fluted segments, in manner as above described."

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21. For an improvement in *Grist Mills;* Edward Gray, Ulysses, New York, March 25.

This improvement consists in placing a pair of small stones in the eye of the runner to prepare the grain before it passes to the large stones. The under one of the two small stones rests upon the driver of the large runner, and revolves with it, and the upper one is driven in the opposite direction by a driver attached to a small shaft, which takes the place of the damsel; its lower gudgeon working in the upper end of the main spindle. The grain is fed into the eye of the small upper stone, and after being partially ground, passes to the large stones to be ground into flour or meal. The defects in the common grist mill, which the patentee says he has overcome, are, "1st. The slowness of the grinding performed around the eye of the common stones, owing to the slow movement of the runner at this part of it, and the consequent insufficient supply of prepared grain for flouring, or being ground into flour, which is accomplished by the surfaces of the stones near the circumferences thereof, where the movement is quicker. And 2nd, the introduction of too much cool air between the stones through the eye of the runner."

The claim is confined to the introduction of the small stones in the eye of the runner. Whether the alleged defects in the old mode are real; and whether, if they are so, they will be remedied by the proposed arrangement, are questions to be decided by the experience of the miller.

22. For improvements in the *Floating Dry Dock;* John Gilbert, city of New York, March 25.

This floating dock is provided with a double sliding gate at one end, through which the vessel enters, and the inside with a boat gate, which can be shifted along lengthwise of the dock, for the purpose of reducing its capacity for receiving vessels of different tonnage. The space between the outer sides of the dock and the inclined partitions or inside walls, is occupied by water-tight tanks, (or rather these spaces are divided by water-tight partitions or bulk heads,) connected with each other, and with a pump well, by means of pipes, governed by cocks or valves, for the purpose of filling them with, or emptying them of, water. On each side of the dock there is a platform running its whole length, on its outside, which is provided with railways and loaded cars, connected with a windlass, by means of chains, for the purpose of trimming the dock. There is a mode of framing or putting the timbers together, which is described, but which cannot be clearly explained in our narrow limits without a drawing. The claims are first to "the employment of a boat gate, in the manner described, for the purpose of dividing the machine into two compartments, in the manner and for the purpose described." "Secondly, the manner of employing movable loaded, or ballast, cars, which are made to run upon suitable rails, or ways, situated on the platform, extended out for that purpose, in order to regulate the centre of gravity of the apparatus, as described." "Thirdly, the particular manner of uniting or putting together the timbers of uniform size, for the construction of the platform and of the sides of the dock, which saves the expense of building stages, as set forth."

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23. For an improvement in *Breast and Pitch Back Water Wheels;* Edward Robbins, Jr., and William Ashby, Bordentown, Burlington county, New Jersey, March 25.

This improvement is designed to admit of the escape of the air which remains in the buckets after they have received the water from the flume, and allowing it to escape through openings in the sole or lining of the wheel, as the buckets, in their descent, are being immersed in the back, or tail race water. The buckets are either radial, or inclined to the radii, and do not reach the sole or lining of the wheel, but leave an open space between the two, which is closed by a flap either hinged to the back of the bucket, or turning on pivots in the shrouding, so as to operate as valves or shutters, the back or inner edge closing against the sole or inner lining directly above the hole made through it for the escape of the air in the bucket below. As the bucket descends, the back of the flap comes in contact with the water in the tail race, which opens it, and passes into the bucket following, forcing the air contained in the bucket above the water, out through the hole in the sole or lining. Were it not for this arrangement, the patentee says the "air would be carried down, and be forced to descend with the buckets through the back water. This carrying down of the air, it must be manifest, would offer a considerable re-

sistance to the motion of the wheel, and that it does so, is well known to us from the most satisfactory experiments which we have made. Having thus fully described the manner in which we construct our improved water wheel, and shown how the same operates, we do hereby declare that we do not claim, as of our invention, the application of valves to buckets, as we are aware that such application had been made prior to our use thereof, but in a way very different from that in which we have made it, and not effecting the same object, namely, the allowing of the free escape of air, and the free admission of water into the buckets, as they dip into the tail race, or back water, and thus preventing the carrying down of the air through said water. What we claim, therefore, as of our invention and desire to secure by letters patent, is the employment of valves in buckets of water wheels, such valves having the position herein described, and being used in combination with the openings through the soling of the wheel, that is to say, said valves forming an angle of 130°, more or less, with the radiating buckets, or with radii of the wheel, and closing against its soling immediately above the opening, for the escape of air."

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24. For an improved mode of constructing *Bedsteads;* Mahlon Gregg, Philadelphia, Pennsylvania, March 25.

This patent is taken for a mode of fastening the rails to the posts, and for tightening the sacking. The tenon on the end of the rail is conical, the smaller end being towards the rail, and they are turned of the solid material. On two opposite sides the conical part is cut off. The mortise in the post being made the reverse of the tenon, it will be evident that it will admit the tenon when presented in one direction and when turned will retain it. The mortise is so formed as to draw the joint tight by turning the rail inwards.

The sacking is attached to a frame inside of the rails, which frame is connected with them. Pins project from the inside of the rails on to which the pieces forming the inner frame slide; those on the side rails are provided with screws and nuts, or with slots and wedges, for the purpose of drawing the sides of the frames towards the rails. The end pieces of the inner frame are formed with inclined planes at each end, against which the ends of the side pieces rest, so that as the side pieces are drawn out, their ends being in contact with the inclined planes of the end pieces, will force them out also, and thus stretch the sacking in all directions. The claim is to this mode of forming the joints of bedsteads, and to the manner of attaching and tightening the sacking.

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25. For an improvement in *Ploughs;* William Bryant, Davidson county, Tennessee, March 31.

This improvement consists simply in attaching, behind the share or cutting part of the plough, a coulter, in such manner as that it shall enter and loosen the ground deeper than it is cut by the share. This coulter is attached to the beam which is extended farther back than usual. The claim is confined to this device.

26. For improvements in *Candlesticks;* William Church, a citizen of the United States, residing at Birmingham, in the county of Warwick, England, issued 31st of March, and patent to run 14 years from the 14th of June, 1838, the date of the English patent.

This patent was granted for a mode of holding the candle in the socket of a candlestick by means of springs arranged in the socket. There are various kinds of springs described and represented, the simplest of which is composed of a series of spring tongues arranged around the socket and attached at the bottom of it. The patentee says, "I desire it to be understood that I claim as my improvement in candlesticks, an elastic holder for the candle, connected to the socket by whatever means and however formed."

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27. For an improvement in *Soap Frames* employed in the manufacture of soap; Joseph Bolton Doe, London, England, issued March 31st, and patent to run 14 years from the 14th of June, 1838, the date of the English patent.

This is an improvement on the well known wooden frames. The improved frames are made of iron or other metal, or compounds of metals, and consist of a bottom plate placed on rollers, to facilitate removal, with the two side plates hinged to it—one end plate being cast with or bolted to each of the side plates, so that by letting down the two sides the ends are also opened, which leaves the cake or block of soap standing on the bottom plate to be cut into bars. After the block has been removed the sides are thrown up, and where the end plate attached to one side meets the other side plate the two are bolted together. The patentee says, "what I claim as constituting my improvement in soap frames is the constructing of such frames from metal or other material which is a good conductor of heat, in the manner herein described; that is to say, by making them in one entire frame, (in lieu of in separate frames placed over each other,) and having movable sides and ends secured together by bolts or other analogous devices, substantially as herein described."

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28. For a machine for *Removing Snow from Railroads;* Charles Lowbaert, Philadelphia, Pennsylvania, issued March 31st, antidated January 15th, 1840.

A platform is placed on the frame of a car above the wheels, and extending some distance beyond the sides of the car frame, to the forward end of which is attached an inclined plane descending to the rails of the road on which it rests, it being properly shod for that purpose. The vertical sides of this platform, which descends to the level of the rails, extend beyond the end of the inclined plane so as to cut the snow before the inclined plane begins to raise it. On the top of the platform there is a triangular frame with one of its angles placed in the middle of the junction of the inclined plane and platform, so as to have two of its sides run out beyond the sides of the platform, to divide the snow which is carried up the inclined plane and discharged

by it on each side. For the purpose of dividing the snow, which is carried up, unequally, should it be desired to discharge more on one side than the other, a board or cutter is hinged to the angle of the frame on the platform and runs out as far as the ends of the sides of the platform, its lower edge resting upon the inclined plane, so as to cut the snow which goes up the plane in unequal parts. This machine is pushed forwards into the snow by the locomotive. "What I claim as my invention," says the patentee, "and desire to secure by letters patent, is the method of dividing and removing snow on railroad tracks, &c., by means of an inclined plane constructed with sides as herein set forth; and of conducting the same from the machine by means of the raised platform, triangular frame, and wings, in combination with the foregoing arrangement, the whole being constructed and operating as described."

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29. For an improvement in the *Rocking Chair;* Samuel H. Bean, Philadelphia, Pennsylvania, March 31.

Instead of having the rockers placed at the bottom of the legs, they are attached to the bottom of the seat, and rock on a frame at the top of the legs. To prevent the seat from being thrown off the stool, there are two metal plates hinged to each rocker by a pin, to give them free play in the direction of the rockers, and passing through mortises in the rails on which the rockers play; they have a shoulder at the lower end which strikes against the under side of the rails should the seat rock too far. The front plate of each set is provided with notches, into which a catch can be driven to prevent the seat from rocking if desired. The patentee claims, as his invention, the "making the seat and stool of the chair in two parts, so that the seat shall rock on the top of the stool, instead of having the parts permanently united, with rockers on the legs of the stool as heretofore; and also the mode of connecting together the seat and stool by the vertical plates attached to the seat passing through the stool with shoulders projecting from the sides thereof which catch against the under side of the stool when the seat is rocked to and fro; and likewise the manner of reclining the seat at any angle required by the lock plates and catches in the hanging plates which receive them, as before described."

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30. For an improved mode of *Preparing Flax and Hemp* before cleaning and separating the fibres; Sands Olcott, New Hope, Pennsylvania, March 31.

The flax or hemp, rotted or not rotted, that has been partially broken is to be converted into an *endless rove or belt.* This may be done by spreading it upon a table, and twisting it so that it will hold firmly, and then splicing the two ends together.

The patentee says, "the advantages of this process are of all the others." "1st. It is more easily and *continually* subjected to the action of the machinery, that will separate the wood and split the fibres." "2nd. It is more easily handled and dried." "3rd. The fibres are kept straight and clear amid the process, and cause less

waste." "What I claim as new, and as my invention, is the shape in which I place the material to be worked, or in other words, the convertion of hemp or flax to be acted on into an *endless rove or belt*, so that it may continue to pass in and out of the machinery, after the manner of a belt."

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31. For an improved mode of constructing *Bales and Drivers for Grain Mills;* Ezra R. Benton, Ohio City, Cuyhoga county, Ohio, March 31.

The claim appended to the specification of this patent gives as clear an idea of the construction as could be given without a drawing; it is in the following words—the letters of reference contained in the original being omitted, viz. "What I claim as my invention, and desire to secure by letters patent, is the connecting of the *bale* and *driver* with corresponding prongs and depressions, constituting a three or two bearing coupling, said couplings being on a level, or nearly so, with a hemispherical depression in the centre of the bale, thus coupling the *bale* and *driver* together, at, or nearly at, the same distance from the face of the stone with the point of the spindle on which the stone is suspended and balanced, in the manner set forth." "I also claim giving the rounding or head form to the sides of the square of the spindle, for the purpose of enabling it to move freely within the mortise of the driver, notwithstanding any bending of the driver upon the spindle."

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32. For improvements in the *Condensing Apparatus of Steam Engines;* Daniel Treadwell, Cambridge, Massachusetts, March 31.

The claim attached to the specification will fully explain the principle of this condenser—it is as follows, viz. "In claiming letters patent for the condenser, as described, I would not be understood as intending my claim to embrace the general principle of condensing by an effusion of water upon the condensing vessel, nor for making said condensing vessel of numerous pipes or tubes, instead of one simple cavity. But my invention, for which I claim a patent, consists in forming the condenser with curved pipes, which pipes pass from, and return to, the same plate by which they are supported, and which plate covers the two cavities, into one of which the steam passes from the exhaust pipe of the engine, and the other receives the water formed by the condensed steam. This form of construction having the following advantages. 1st. All the pipes are supported by the same body. 2nd. They are all opened to be cleaned, by a removal of the back plate. 3rd. They are free to expand and contract without causing their ends to move. 4th. The outside of the pipes are open and exposed, so that they can be cleaned without removing any part on which their support depends. 5th. They are, by means of being secured by soldering to the plate, placed nearer together than in any other form of fixture."

33. For *Preparing White Lead Paint;* James N. Trovillo, Christiansburg, Virginia, March 31.

This improvement consists in incorporating with a given quantity of white lead, equal, or nearly equal, quantities of linseed oil and of pure water, preparatory to grinding the paint, by first carefully incorporating the water and lead, and then adding the oil, and also in subsequently reducing it to a proper consistence by the addition of the same materials in the same proportions. The patentee says, "I do not claim to be the first to have incorporated linseed oil and water together in the preparation of paint, with a view to economy in the use of the former article, this having been done by the aid of lime or other alkaline substances; but what I do claim, is the producing of this combination by the agency of white lead alone, substantially in the manner set forth, for the purpose of producing a mixture to be employed as a paint applicable to all the objects to which white lead paint is ordinarily applied."

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34. For an improvement in *Steam Boilers;* Jacob B. Eversole, St. Louis, Missouri, March 31.

The patentee states that the object of his improvement is to prevent the vapour, generated at the bottom of the boiler, from coming in contact with the bottom of the flue, and there forming a sheet, which prevents the water from coming in contact with the heated metal. This he effects by means of a semi-cylindrical guard plate of metal, which he places between the bottom of the flue and the bottom of the boiler, and supports by legs or rods resting on the latter. The steam that is generated at the bottom of the boiler, in rising, comes in contact with the bottom of the guard plate, which carries it up and prevents it from coming in contact with the bottom of the flue. It is evident, however, that the remedy will only be partial, for the steam which impinges upon the bottom of the guard plate, will soon elevate its temperature until it becomes nearly equal to that of the steam—and this will generate steam above the guard plate, which, in rising, will impinge upon the bottom of the flue. The claim is confined to the placing of a guard plate between the flue and the bottom of the boiler.

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35. For improvements in *Machinery for removing Stumps;* Miles C. Mix, Tompkins county, New York, March 31.

It would be useless to attempt to give a clear idea of this machine within the narrow limits of this notice, without drawings; suffice it to say, that the chain which is attached to the stump, and by which it is drawn up, is attached to a revolving shaft, on which it is wound as on a windlass, by means of a peculiarly arranged system of gearing, which facilitates the change of relative velocity between the point where the force is applied and the shaft on which the chain is wound. This shaft and gearing are placed in a frame provided with two wheels at one end, and a truck roller at the other, so arranged as to

allow the ends of the frame to rest on the ground, that the whole may be attached or anchored for operation.

The claim is in the following words, viz. "What I claim as my invention, is the particular manner of obtaining the power by the construction and arrangement of the gearing, as herein described, that is to say, the mode of operating by two or more sets of double pinions on two differential wheels through the intermedium, and by means, of an apparatus combined and connected substantially, as herein set forth."

Proceedings in an Appeal from the decision of the Commissioner of Patents, Henry L. Ellsworth, Esq., *rejecting the application of* John F. Kemper, Esq., *of Cincinnati, Ohio, for a Patent for an improvement in the manner of stowing Ice.*

The Editor was employed by Mr. Kemper to solicit and obtain a Patent for "*certain improvements in the manner of constructing vessels for carrying and stowing ice, and also an improvement in the manner of stowing the same;*" which application was duly made, and the claim to the manner of constructing the vessels admitted, while that to the manner of stowing the ice, was rejected, by the Commissioner of Patents, as not being, in his opinion, the proper subject of a Patent, and upon this decision, the subjoined proceedings have been had.

Under the provisions of the 7th section of the act of July 4th, 1836, an appeal from the decision of the Commissioner was allowed, in certain cases, to a board of examiners, consisting of three persons, to be appointed by the Secretary of State. Several appeals were made under this act, but the mode of proceeding was liable to so many objections as to render the repeal of this provision not only desirable, but absolutely necessary; on the 3rd of March, 1839, "an act in addition to an act to promote the progress of the useful arts," was passed, the 11th and 12th sections of which are in the following words.

"Sec. 11. *And be it further enacted*, That in cases where an appeal is now allowed by law from the decision of the Commissioner of Patents to a board of examiners provided for in the seventh section of the act to which this is additional, the party, instead thereof, shall have a right to appeal to the Chief Justice of the District Court of the United States for the District of Columbia, by giving notice thereof to the Commissioner, and filing in the Patent Office, within such time as the Commissioner shall appoint, his reasons of appeal, specifically set forth in writing, and also paying into the Patent Office, to the credit of the patent fund, the sum of twenty-five dollars. And it shall be the duty of said Chief Justice, on petition, to hear and determine all such appeals, and to revise such decisions in a summary way, on the evidence produced before the Commissioner, at such early and convenient time as he may appoint, first notifying the Commissioner of the time and place of hearing, whose duty it shall be to give notice thereof to all parties who appear to be interested therein, in such

manner as said judge shall prescribe. The Commissioner shall also lay before the said judge all the original papers and evidence in the case, together with the grounds of his decision, fully set forth in writing, touching all the points involved by the reasons of appeal, to which the revision shall be confined. And at the request of any party interested, or at the desire of the judge, the Commissioner and the examiners in the Patent Office, may be examined under oath, in explanation of the principles of the machine or other thing for which a patent, in such case, is prayed for. And it shall be the duty of the said judge, after the hearing of any such case, to return all the papers to the Commissioner, with a certificate of his proceedings and decision, which shall be entered of record in the Patent Office; and such decision, so certified, shall govern the further proceedings of the Commissioner in such case: *Provided, however*, That no opinion or decision of the judge in any such case shall preclude any person interested in favour or against the validity of any patent which has been or may hereafter be granted, from the right to contest the same in any judicial court, in any action in which its validity may come in question.

Sec. 12. *And be it further enacted*, That the Commissioner of Patents shall have power to make all such regulations in respect to the taking of evidence to be used in contested cases before him, as may be just and reasonable. And so much of the act to which this is additional as provides for a board of examiners, is hereby repealed."

During the period that has elapsed since the passing of the foregoing amendments to the act of 1836, the Editor has been consulted by a number of persons proposing to appeal from the decisions of the Commissioner, adverse to their claims, but he has, in every instance, discouraged the making of such appeal, because in prosecuting it a certain expense must be incurred, and the probable result would be the sustaining of the Office by the Chief Justice. The considerations upon which this advice has been founded, have been that these decisions were, in most instances, believed to be correct, and that where their correctness was matter of doubt, it was not likely that the testimony and opinions presented to the judge would, in ordinary cases, make it clearly his duty to order a patent to issue. By ordinary cases, are intended those in which the question at issue is that of novelty in the invention; a question to be decided upon the substantial identity of two machines, somewhat different in form. This is frequently a very difficult question with the professed mechanician, and one which cannot be viewed as within the purview of those subjects with which it is the duty of a jurist to be familiar; the tendency, therefore, would be, in nearly all cases, to lean to the side of the office, as the Commissioner and Examiners must be supposed to be well acquainted with such matters, and not to have any interest adverse to that of the applicant for a patent. These officers the Judge may examine under oath, and their opinions and reasons must necessarily have great weight in his decision upon the appeal.

Persons who apply for patents do so, generally, under an impression that they have something which is new and useful, and when disappointed in their cherished hopes, by an adverse opinion in the

Patent Office, are prone to apprehend the existence of some improper motive, and not unfrequently ascribe to corruption any decision which contravenes their own opinions of what ought to be, and the Editor is aware that charges of this character against the office, have been extensively promulgated; from his constant intercourse with it, and his intimate acquaintance with its transactions, it is due equally to himself and to justice, here to declare, that he is convinced such charges have not even the shadow of a foundation as their basis. He has frequently differed from the office in matters of opinion, and has forcibly urged the claims of his clients where he has felt that they were just; the present is a case in point; he has believed, and does still believe, that Mr. Kemper had a perfect right to a patent. At the moment of penning these preliminary remarks, the Editor is not in possession of the decision of the Chief Justice in the matter, but anticipates with much confidence that it will be in favour of his client. Should it not be so, however, although he will feel much disappointment, he will, at the same time, be ready to distrust the correctness of his own views in the matter, as the question submitted is one of law, and therefore within the special province of the Judge, and is in the hands of one who is equally able and faithful in the performance of his duties. It was because the point at issue was a question of law that Mr. Kemper was encouraged to make the appeal, and in whatever way it may be decided, a rule will be established which will govern the course of the office in analogous cases.

Two years have elapsed since the passing of the law giving an appeal to the Chief Justice of the District, and as the present is the first appeal under it, there was no existing precedent to determine the form of procedure, the publication of all the documents in the case may be of some value as a guide in such as may hereafter occur. By the delay of a day, the decision of the Chief Justice would be known, but the wish of the Editor to publish the case immediately, and his distance from the press, induce him to send off the first part of his copy, in order that it may be in time for the current number of the Journal.

Washington, March 20th, 1841.

To the Commissioner of Patents.

Sir—As Attorney for, and in behalf of John F. Kemper, of Cincinnati, in the State of Ohio, I hereby appeal from the decision of the Patent Office, in the case of the application of the said John F. Kemper for a patent for "certain improvements in the manner of constructing vessels for carrying and stowing ice; and also an improvement in the manner of stowing the same." You are, therefore, hereby requested to take such steps in the premises as are directed and provided by the 11th section of the "Act in addition to an act to promote the progress of the useful arts," passed on the 3rd day of March, 1839; twenty-five dollars having been paid into the Treasury of the United

States, in conformity with the requirements of the act of Congress in that case, made and provided.

THOMAS P. JONES, Attorney for JOHN F. KEMPER.

Washington, December 14th, 1840.

To the Hon. WILLIAM CRANCH, *Chief Justice of the District Court of the United States for the District of Columbia.*

The petition of John F. Kemper, by his Attorney, Thomas P. Jones, respectfully represents, that he has made application to the Commissioner of Patents, for the grant of letters patent of the United States, for "certain improvements in the manner of constructing vessels for carrying and stowing ice; and also an improvement in the manner of stowing the same;" that the Commissioner of Patents has decided that a patent cannot be granted for the last item in his said improvement, to wit: "an improvement in the manner of stowing the same," which decision your petitioner verily believes to be in contravention of his rights as the inventor or discoverer thereof, for reasons which will be fully set forth, at such time as may be appointed, agreeably to the provision of the 11th section of the act of Congress, entitled "An act in addition to an act to promote the progress of the useful arts," passed on the 3rd day of March, 1839. Your petitioner having paid twenty-five dollars into the Treasury of the United States, and having also given notice to the Commissioner of Patents of this appeal.

All of which is respectfully submitted.

JOHN F. KEMPER.

By his Attorney THOMAS P. JONES.

Washington, March 14th, 1840.

To the Hon. WM. CRANCH, *Chief Justice of the United States Court for the District of Columbia.*

Thomas P. Jones, Attorney for John F. Kemper, presents the following statement, and plea, on the claim of said John F. Kemper to a patent for what is believed to be a new and useful discovery.

In the case of John F. Kemper, of Cincinnati, in the state of Ohio, who has made application to the Commissioner of Patents for a patent for "certain improvements in the manner of constructing vessels for carrying and stowing ice; and also an improvement in the manner of stowing the same;" a letter was received from the Commissioner of Patents, dated March 24th, 1840, of which the following is a copy.

Patent Office, March 24th, 1840.

"SIR,—The specification of your improved vessel for stowing and carrying ice is herewith returned for amendment in the claim, which is deemed to be too broad, the mode of arranging the ice by placing the blocks edgewise, cannot, in the judgment of this office, constitute a claim to a patent, as it is believed that every one has a right to pack away ice by placing the blocks either edgewise or in any other posi-

tion. The mode of caulking does not present any thing substantially new, the same having long since been effected.

Yours, respectfully,
H. L. Ellsworth."

Mr. John F. Kemper.
Care of Dr. T. P. Jones, Agent, Washington, D. C.

After the receipt of the foregoing letter, I had, on behalf of Mr. Kemper, several conversations with the Examiner of Patents, upon whose report the foregoing letter was founded, and as these did not result in any change of opinion, it was proposed to refer the question to the final decision of the Commissioner of Patents; upon this point, and on some others, I subsequently corresponded and consulted with Mr. Kemper, and finally the question of his right to a patent under that part of his specification and claim which relates to the packing of ice edgewise, was submitted to the Commissioner. The part in controversy, so submitted, and as contained in the specification and claim, is in the following words.

"I have discovered that for the purpose of keeping ice for a great length of time, it is necessary, in stowing it, to place all the pieces edgewise, as when placed flatwise, small openings are formed through it by the percolation of water, or otherwise; and that this injurious effect goes on increasing, and, eventually, producing a rapid destruction thereof. This I obviate by carefully packing all the blocks edgewise, when, as experience has abundantly shown, no such effect is produced. This mode of stowage applies not only to vessels but also to ice houses, &c., and wherever ice is to be preserved.

"In the manner of stowing the ice, I claim the placing of the prepared blocks edgewise, in the manner, and for the beneficial purpose, herein set forth."

On, or about, the 10th of September, a paper was placed in my hands, by the Commissioner of Patents, of which the following is a copy.

"Ice houses have been packed either by placing the ice on the edge, or flatways, indiscriminately; if one person finds that placed on the end keeps best, and uses accordingly, this is no invention.

"If apples keep best on the end, a patent would not be granted for the exclusive use of packing them thus, though generally they are thrown in promiscuously. If cider would keep better by placing the bottles horizontally, than allowing them to stand upright, this could not be patented, as both methods are used; in neither case is there any thing new. The applicant only uses the invention or directions of another, and finds one course recommended better than another.

H. L. Ellsworth."

It appears to me that in the case in hand the office has entirely mistaken its powers and its duties, and has assumed an authority not intended to be given to it by the legislature.

Under the laws of the United States patents are granted for "any new and useful art, machine, manufacture, or composition of mat-

ter; or any new and useful improvement on any art, machine, manufacture, or composition of matter, not known or used by others before his or their discovery or invention." Act of July 4th, 1836, sec. 6.

The powers of the office to grant or to refuse a patent are designated in the 7th section of the same act, where it is provided that "if on any such examination it shall not appear to the Commissioner that the same had been invented or discovered by any other person in this country prior to the alleged invention or discovery thereof by the applicant; or that it had been patented or described in any printed publication in this or any foreign country, or had been in public use, or on sale with the applicant's consent or allowance prior to the application, if the Commissioner shall deem it to be sufficiently useful and important, it shall be his duty to issue a patent thereof."

It is not pretended in either of the communications from the office, above cited, that the discovery in question is placed in either of the conditions that would justify the refusing of a patent, under the law. In that of March 24th it is said to be "believed that every one has a right to pack away ice by placing the blocks either edgewise or in any other position;" a right which most certainly is not disputed; but the same may be said of the use of any invention or discovery that has ever been made; every one had *a right* to make it, and having made it, if not injurious to the community, he would have had *a right* to use it; and were there not a law vesting an exclusive right in inventions or discoveries, under certain conditions, every one else would have had the same right; the averment in the foregoing quotation seems, therefore, not to be based on any tenable ground. Does it appear "that this alleged discovery had been patented or described in any printed publication in this or any foreign country, or had been in public use?" this is not pretended; nor is it alleged that "the Commissioner" does not "deem it sufficiently useful and important," and is it not, therefore, "his duty to issue a patent therefor?"

The allegation of my client as respects the beneficial results of his manner of stowing ice, has been made after repeated and comparative trials; and he is fully satisfied of the verity of the discovery; such being the fact, it does not require any laboured argument to show that it is a discovery of very great value. In stowing ice, the whole intention is to preserve it either on voyages or for domestic use; and any new mode of constructing an ice house for that purpose would, confessedly, be patentable. In the case before us, the office assents to the grant of a patent for the construction of a vessel in which the ice is to be stowed, but refuses one for a new manner of stowing it, because, according to its statement, "every one has a right to pack ice away by placing the blocks either edgewise or in any other position." So also every one had a right to build a vessel for preserving ice, just as Mr. Kemper has built his; and yet an exclusive right to its use is granted to him for fourteen years, whilst it is refused for an auxiliary means of attaining the same end.

The communication from the office, received, as above stated, on or about the 10th of September last, seems to me not to offer any valid reason for not granting the patent. Ice has been thrown, or packed, in

ice houses "indiscriminately;" and from this it seems to be inferred that a discriminating mode, which it is alleged and believed produces a new and useful effect, is not the subject of a patent; and why? because "if one person finds that ice placed on the ends keeps best, and uses accordingly, this is no invention." Is it no "discovery" for one to find out what had not before been known, that "placed edgewise," the blocks of ice will be preserved for a much longer time than when placed *indiscriminately?*

The illustration offered in the supposed case of apples keeping best on their ends may be passed over, as it is merely followed by a declaration "that a patent would not be granted for the exclusive use of packing them thus." Whether it would, or ought, to be granted, is not a question which I am called to discuss. The remark respecting cider in bottles is still less relevent, as it is stated that "both methods are used," and that, therefore, the laying them on their sides "could not be patented," a conclusion, the correctness of which is fully admitted; but how this is to be applied to a method of packing ice, which method *has not been used*, does not appear.

On the 4th of May, 1838, a patent for an improved mode of packing and stowing ice, was granted to Frederick Tudor, of Boston. The improvement consisted simply in filling the interstices between the blocks of ice with any nonconducting material, such as saw-dust, chaff, pulverized cork, or any other that may be preferred. The patentee says, "my improvement consisting entirely in the filling of the spaces usually left between the separate blocks of ice with any suitable non-conductor, it having been found that by so doing the ice is preserved from melting for a much longer period than usual." The main object in this case was, it is supposed, to exclude the atmospheric air. If the applicant had been told that every one had a right to pack away ice by placing chaff, &c., between the separate blocks, as well as to surround the whole mass with such materials, he would have been placed in a predicament like that of my client; but in this case the patent was granted, and most certainly for what was less obviously a new discovery then is the fact that by packing the whole mass edgewise, the ice will be preserved from melting for a much longer period than usual.

I might give a long list of patents for processes, or modes of procedure, in preserving animal and vegetable substances, by means extremely simple, which have been granted and sustained under the statute of monopolies in England, the wording of which is much more limited than our own statute in its enumeration of patentable subjects; and I might also cite many which have been granted, and I believe correctly granted, under the existing laws, by the patent office of the United States, which appear to rest upon a much narrower basis than that now demanded; but this I consider at present unnecessary, especially when addressing myself on a question of law, to one having the requisite materials at his command, and so much better prepared to use them aright, than I can pretend to be.

In deciding upon the right of an applicant to a patent the professed rule of the office is, "that where the question is at all doubtful, the

patent should be granted," as the final decision of the right, in such cases, belongs to the courts, and not to the Commissioner of Patents; this rule I am fully aware has, in most cases, been faithfully observed, and I am really at a loss, therefore, to perceive upon what ground it has been so widely departed from in the present instance. Is the proposed plan unquestionably old? This is not even hinted at. Is it "frivolous or injurious to the well being, good policy, or sound morals of society?" Assuredly not. [See 1 Mason 186, Lowell *v.* Lewis.] I therefore most confidently anticipate that your honour will see good ground to reverse the decision of the Commissioner of Patents, and direct that a patent be issued to my client, admitting his claim to "the placing of the prepared blocks edgewise, in the manner and for the beneficial purpose herein set forth."

THOMAS P. JONES, Attorney for John F. Kemper.

To the Hon. WM. CRANCH, *Chief Justice of the United States Court for the District of Columbia.*

The Commissioner of Patents presents to the Honorable Judge, the following as the reasons which governed him in the rejection of John F. Kemper's claim to a patent for a mode of packing ice in vessels for transportation, and in ice houses.

John F. Kemper of Cincinnati, Ohio, made application for a patent on the 20th of March, 1840, for "improvements in the manner of constructing vessels for the stowing and carrying of ice, and also for an improvement in the manner of stowing the same in vessels and ice houses."

No objection has been made to the grant of a patent for the novel construction of vessels for the transportation of ice as claimed by him, but the Commissioner of Patents decided that he was not entitled to receive a patent for the manner of stowing the ice by placing the blocks edgewise, nor for the caulking between the several blocks as described and claimed in his specification—the former because, in the judgment of the Commissioner, it could not constitute a legitimate claim to a patent, for the want of novelty; and the latter for the want of novelty. From the decision on the former, viz. the mode of stowing by placing the blocks edgewise, he has appealed, and to the latter, viz., the caulking between the blocks he has acquiesced.

The Commissioner indulges the belief that a bare statement of the objections to the grant of a patent for stowing ice by placing the blocks edgewise, without any laboured arguments, will explain to the Honorable Judge the soundness of his decision.

It will not be pretended by any one that blocks of ice have not been placed edgewise in vessels for transportation, and in ice houses for preservation. The fact is too well known to need proof.—In vessels the blocks have been placed in every possible position with the view of saving room in stowing, and any one who has seen ice stowed away in ice houses must have observed that the blocks are frequently placed edgewise. If then blocks of ice have been thus placed, the position has not been invented by Mr. Kemper. What then has been

invented? Is it placing all the blocks edgewise? This is not, however, an invention, for it matters not whether two or one thousand blocks have been thus placed, as the greater or lesser number cannot constitute a claim to a patent. Is it then the discovery that blocks of ice thus placed will be preserved longer than when placed in any other position? The stress laid upon this fact by Mr. Kemper's attorney, in the specification, and in his argument, indicates that this is the main ground of his claim. If a discovery were the subject of a patent this would be a good claim on the score of novelty, but it is believed that the test of usefulness would have to be applied with great liberality, as it has been shown by experience that the more compact ice can be packed, the longer it will keep, for one large solid block will keep longer than several small pieces of an equal bulk placed side by side. It is believed that if ice were placed edgewise a passage would sooner be made for air or water, by the melting of the ice on the sides, than if laid flatwise; for, in the former case, water trickling down, would, by attraction, continue in contact with the block in passing from the upper to the lower edge, but in the latter, it would remain upon the surface and only in contact with as much of the ice as it could cover in a state of rest—but to return. A discovery, is to bring to light something which has had existence before, and the very reverse of an invention, which is the contriving or producing something which did not before exist. It is not deemed necessary to go into a minute investigation of the meaning of the two terms to be submitted to one who needs no such explanation. The decisions of the courts are replete with opinions against the grant of patents for discoveries except when the term is used as synonimous with invention. As, for instance, a learned judge argues, he who discovered atmospheric pressure was not entitled to receive a patent for such discovery, but he who invented the suction pump, contrived something which did not exist before, and was entitled to receive a patent for it. So of the barometer. And, again, the man who discovered that steam in expanding exerted great force, was not an inventor, but the one who contrived the steam engine was. The courts have also decided that the application of a known thing to a new purpose is not the subject of a patent.

A machine has been invented for a given purpose, and another person discovers that it can be advantageously applied to another purpose—this is to disclose or discover something not known before, but it is not inventing or contriving, and therefore not patentable. It cannot be seen by what process of ratiocination it can be shown that *position can be invented*—it has existed from the beginning of time, and cannot be the subject of invention. Nor can it be shown that, to discover by any series of experiments, or by accident, that a certain position of any thing produces a beneficial result, is an invention and patentable under the statute. As well say that a person who should discover that to plant a given kind of seed so many inches under ground would make it produce better, and that for it he would be entitled to receive a patent. Or that he who should discover that certain winds prevailed during the winter, and that to build houses with the gable

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side towards such winds would make the house warmer, and that for such discovery he would be entitled to a patent. Or that he who should discover that piling wood vertically, instead of horizontally, would keep better, would, for that, be entitled to receive a patent, and thus prohibit all others from piling wood vertically. The grant of a patent for placing the blocks edgewise, for this purpose, would prevent any one from placing them in the same position for another object; and if it would prevent them from stowing away a whole cargo, it would prevent them from stowing away a part of a cargo, and thus all persons would be prohibited from placing blocks of ice edgewise. Can it be believed that the Legislature ever intended thus to restrict the public right? It cannot be. Other arguments might be advanced, but it is believed to be so plain as to need no other illustration.

The Commissioner will notice an argument advanced by Mr. Kemper's attorney.—He has referred to a patent granted to Frederick Tudor, of Boston, on the 4th of May, 1838, for an improved mode of packing ice, by filling up the interstices between the blocks of ice with any non-conducting material. This is cited as a precedent.

Upon a review of this patent the novelty does appear questionable; but it matters not, as the case is not in point—there is no analogy between it and placing blocks of ice edgewise. It was known that the interstices between blocks of ice would admit air, and that if the air should be of a temperature above the freezing point, the consequence would be the melting of the ice; this is a discovery and not patentable, but he contrived a mode of preventing it by filling up the interstices with some non-conducting material. This is an invention, and as such, the subject of a patent; but if the interstices between blocks of ice had been filled up with some non-conducting material before, for some other purpose, and Mr. Tudor had merely discovered that it would prevent the admission of air, and thus the melting of the ice, he would not have been entitled to a patent. This supposed case is analogous to Mr. Kemper's claim, but as the patent was granted for the contrivance, it bears no analogy. If the contrivance, or invention, patented by Mr. Tudor was not new at the time the patent was granted, then it only shows that the patent ought not to have been granted, but it is no argument in favour of the present claim.

The Commissioner will remark, in conclusion, that there is another and insuperable objection to the claim in question.

Mr. Kemper's application covers two separate and distinct inventions which cannot be included in or covered by one patent, viz—improvements in the construction of vessels for the transportation of ice, without reference to the manner of packing or stowing away the ice, and also improvements in the manner of packing or stowing ice in vessels and in ice houses. The two have no dependence upon each other. The vessel can be used for transporting ice packed in any manner,—and the method of packing can be used in vessels thus constructed, or in any other manner, or in ice houses of all constructions.

All of which is respectfully submitted.

HENRY L. ELLSWORTH.

February 17*th*, 1841.

To the Hon. Wm. Cranch, *Chief Justice of the United States Court for the District of Columbia.*

Sir—As Attorney for Mr. John F. Kemper, I present to your consideration the following remarks in answer to the reasons given by the Commissioner of Patents for his rejection of the claim of Mr. Kemper, to his mode of stowing ice.

It is said, by the Commissioner, that he, Kemper, "was not entitled to receive a patent for the manner of stowing ice, by placing the blocks edgewise," "because, in the judgment of the Commissioner, it would not constitute a legitimate claim to a patent, and for want of novelty." It is also said that "it will not be pretended by any one that blocks of ice have not been placed edgewise in vessels for transportation, and in ice houses for preservation. The fact is too well known to need proof." A *discovery*, it is also argued, cannot be the subject of a patent, and that "it cannot be seen by what process of ratiocination it can be shown that *position can be invented.*"

It is somewhat strange that it should be asserted that a *discovery* is not the subject of a patent, when the provisions of the constitution of the United States, upon which the patent law is founded, gives to Congress the power of securing "to authors and inventors, the exclusive right to their respective writings, and *discoveries.*" It is admitted that a *discovery*, taken abstractedly, is not patentable, but if the thing discovered be practically applied to produce a new and useful effect, the manner of attaining this end is patentable. The 6th section of the act of July 4th, 1836, provides "that any person having *discovered* or invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement on any art," &c.

The question at issue is whether Mr. Kemper has made any such "new and useful improvement on any art" as to entitle him to the protection of the patent law; and, to the undersigned, it seems that few things are more palpable than the obligation to answer this question in the affirmative. Is it not admitted that the art of preserving ice is a useful art? Improved modes of constructing ice houses have been the subjects of patents both here and in England; the office, in the case before us, has allowed the claim to the manner of forming a structure for this purpose, but has refused it for a new method of stowing the ice, by which the end proposed is more effectually attained. Is it not an improvement in the art of preserving ice, so to dispose the blocks as that they shall be prevented from melting for a longer period of time than has heretofore been done? The assertion that "it will not be pretended by any one that blocks of ice have not been placed edgewise in vessels for transportation, and in ice houses for preservation," appears to be based upon ground altogether untenable, as it certainly "will not be pretended," that in vessels or in ice houses, ice had ever been stowed away upon the system adopted by Mr. Kemper; and this new and useful improvement in the art is founded upon a discovery made by him, namely, that if a mass of ice be stowed away in such manner as that the part which formed

the edges in the act of freezing, are placed in the reverse position when stowed away, the process of melting, or thawing, will be thereby retarded. I will ask, Sir, had this discovery ever been made, or the improved mode of stowing, founded upon it, ever been practiced before by any other person? That this is the case is not pretended. To say that because in filling ice houses, or vessels, with ice thrown in at random, some of the pieces so thrown in would assume the position designated, the claim to a new system of stowing ice would be invalidated, is to assert that, the unsoundness of which is too evident to call for any laboured arguments for its refutation.

In the well known case of the achromatic telescope, invented by Dolland, it was shown that a Dr. Hall, of Scotland, had constructed two telescopes upon the same principle with that of Dolland's forty years before his invention of it, but had not pursued the matter either to his own benefit or to that of the public; Dolland was, therefore, held to be the true inventor, and his patent was sustained. In this case there was, on the part of Hall, study, design, and system; but we are now to be told that because in throwing or heaping together a quantity of ice in separate pieces, some of these pieces will fall in the position designated by Mr. Kemper, he is not entitled to a patent. It certainly, Sir, is not necessary to inform you, or the Commissioner of Patents, that it is a settled principle in law, that a patent cannot be invalidated by showing that something of the nature of the thing patented had fortuitously occurred, or had been produced, without its attracting due attention, and leading to any beneficial result. It is probable that there are but few of those processes in chemistry by which new compounds have been produced, and for which patents have been granted, that had not previously been accidentally and unwittingly performed; but would proof of this invalidate a patent? In the case before you, Sir, no such evidence can be stated, and the doctrine assumed, were it tenable, would invalidate a large proportion of the patents that have been issued and sustained.

The argument attempted to be founded on the matter of Tudor's patent, cited by me in my first communication, appears to be altogether forced and inconclusive. It is not pretended by me that a discovery *per se* is the subject of a patent; but every invention must be founded on some discovery; and when a fact is discovered, and this discovery leads to some new and useful procedure, such procedure becomes a patentable subject. The discovery may be made by one person, and the patentable application of it by another, and such is usually the case; but in the present instance, they are both the work of the same individual, Mr. Kemper having discovered that ice exposed to the action of those agents which dissolve it, is, when placed edgewise, affected by them much more slowly than when piled or packed indiscriminately, in the ordinary way; and upon this discovery he founds a new and useful system of packing or stowing ice, and of thus preserving it, unmelted, for a longer period than by any other mode previously adopted. We are informed that Mr. Tudor did not make any discovery, but that he invented a mode of preserving the blocks of ice from decay, by filling the interstices between them with some non-

conducting substance, that excluded the air. It is said that "if the interstices between blocks of ice had been filled up with some non-conducting material before, for some other purpose, and Mr. Tudor had merely discovered that it would prevent the admission of air, and thus the melting of the ice, he would not have been entitled to a patent." It is then asserted that "this supposed case is analogous to Mr. Kemper's claim." Such, however, is not the fact, there is not any analogy between the two cases. Mr. Kemper, in his claim, says, "In the manner of stowing the ice, I claim the placing of the prepared blocks edgewise, in the manner, and for the beneficial purpose herein set forth." His claim, therefore, is to the doing of a new thing, one that had never been done before, either by accident or design, and by which mode of procedure a new and beneficial result is secured.

The Commissioner is at a loss to see how it can "be shown that position can be invented;" and this declaration is followed by some observations respecting position, the incorrectness and inapplicability of which are, it seems to me, quite evident. The position in which propellers have been placed on steamboats; the position in which the buckets of such wheels have been placed, and of a thousand other things in which position constituted the leading improvement, might be cited in proof of the utter irrelevency of such a remark. Within a few days a patent has been granted to Mr. Wm. W. Van Loan, of Cattskill, New York, for placing the ordinary paddle wheels of steamboats in a position which they had not previously been made to occupy. Instead of standing vertically, they are placed obliquely, and the claim made, and admitted by the office, is in the following words. "These wheels are to be moved by means of cranks, or in any of the known ways in which propelling wheels are made to revolve; the only novelty in my invention being the *position* in which I place said wheels, and cause the paddles to operate. What I claim, therefore, as constituting my improvement, and desire to secure by letters patent, is the placing of the said wheels in the *position* herein fully made known and represented, so that they shall enter the water in a direction similar to that of oars in the ordinary process of rowing, the whole operating substantially in the manner described."

It is said by the Commissioner, in relationship to Mr. Kemper's mode of stowing ice, that "it is believed that the test of usefulness would have to be applied with great liberality." And this remark is followed by some conjectures respecting the supposed result of stowing ice edgewise. This, sir, I conceive, is not a question upon which the Commissioner is to decide. On this point I will merely quote from Judge Story's opinion in the case of Lowell *v.* Lewis, 1. Mason 132. "In my judgment the argument is without foundation, all that the law requires is that the invention should not be frivolous, or injurious to the well being, good policy, or sound morals of society. The word *useful*, therefore, is incorporated into the act in contradistinction to mischievous, or immoral. For instance, a new invention to poison people, or to promote debauchery, or to facilitate private assassination, is not a patentable invention. But if the invention steers wide of these objections, whether it be more or less useful is a cir-

cumstance very material to the interest of the patentee, but of no importance to the public. If it be not extensively useful it will silently sink into contempt and disregard."

It is now stated, for the first time, that "Mr. Kemper's application covers two separate and distinct inventions, which cannot be included in, or covered by, one patent," and the Commissioner avers that this "constitutes an insuperable objection to the claim in question." Although it is believed that the opinion thus given is not invulnerable, as the construction of the vessel, and the manner of stowing the ice are part and parcel of one single invention, the preservation of the ice, yet, waiving this consideration, the only result would be that my client must obtain two separate patents, instead of including the two claims in one. The matter before you, Sir, is not a question upon the payment of thirty dollars into the Treasury of the United States, but upon the right of my client to a patent for a new and useful improvement in the manner of preserving ice.

In conclusion, Sir, I will now refer to two cases of the grant of patents by the office, in addition to that of Tudor's, cited by me in my former statement and plea; my object in this case being to show that it has been the practice of the office to grant patents upon claims of a very doubtful character, and, as I believe, on the ground of their being doubtful. These cases are such as have been decided since the passing of the Act of July 4th, 1836, giving to the Commissioner of Patents a certain extent of judicial power in relation to the granting of patents, in addition to the ministerial duties imposed by the Acts of Congress formerly existing. I might cite a number of other cases, with a similar view, but I do not deem it necessary so to do.

On the 15th of February, 1838, a patent was granted to A. D. Ditmars, under the claim to "the preservation of grass for hay, by excluding it from the air, in sheet lead, in the manner set forth." This manner consisted in the forming of air tight bins, or boxes, in barns, &c., which boxes were to be lined with sheet lead, and the lids of which were to be secured down, either by soldering, or otherwise, in such manner as to exclude the air. The grass was to be placed in these boxes in its green state, but free from dew or rain, and it was avered that by this means it would be preserved from decay.

On the 16th of November, 1839, a patent was granted to John H. Stevens for an improvement in friction matches. This improvement consisted in the preserving of the matches from accidental ignition by covering them with a coat of varnish, and it is stated that for this purpose various substances might be employed; what is generally used "is a little solution of gum mastic made with spirits of turpentine, or of an alcoholic solution of gum copal, or of gum mastic; but other glutinous gums, resins, tenaceous matters, or compounds, may be used."

These cases will serve to show that the amount of novelty required by the office to justify it in the granting of a patent is but small, and such must necessarily be the case if its object is, as the Act of Congress establishing it indicates, to "Promote the progress of the Useful Arts," for under any other manner of procedure its tendency would be to

impede their progress. In the case of Ditmars, the patentee had made no new discovery, it having been a well known and long established fact, that the exclusion of air tended to retard putrefaction, but he had applied a well known principle to the attaining of a useful, and it may be, of a new, end; in his procedure there was very little of invention, and it is believed that his title to a patent must have been a matter of much doubt, and that in consequence of the existence of this doubt, the patent was granted to him.

In the case of Stevens, the novelty was, perhaps, still less than that in Ditmars. The coating of wood with varnish to protect it from moisture, and for other purposes, is a thing known to every person, yet as it was, no doubt, believed to produce a new and useful effect in its application to the friction match, the office ordered the patent to issue.

The right of my client to a patent, from the considerations urged, appears to me so manifest as really to render the demurring of the office in the matter, a subject of surprise, as I well know that the objections made have not originated in any improper motive, or bias; but I am compelled to believe that a doubt having been at first entertained and expressed, the pride of consistency, however unwillingly, has entered, to no small extent, into the reasoning upon which this doubt has been made to assume the form of absolute decision. In every case, and there have been a number, in which my clients have proposed to appeal from the decision of the office, adverse to their claims, I have advised submission, but in the present instance I have believed that the appeal provided for in such cases was due to a full and just examination of the matter in question.

All which is respectfully submitted.

Thos. P. Jones, Attorney for John F. Kemper.

Washington, March 14*th.*, 1841.

TO BE CONTINUED.

The Mathematical Power Loom.—By the introduction of this invention it is expected a powerful stimulus will be given to a staple manufacture in this country—viz., the linen trade, which has for many years been in a drooping state, chiefly owing to the low price of labour in Scotland. The mathematical loom is equally applicable to the manufacture of worsted, cotton, and all other fibrous substances. This machine is called a mathematical loom, because the quantity of weft, or woof, is determined by calculation or measurement, thus securing at pleasure cloth of any fabric or stoutness, and perfectly equal throughout. The pressure upon the warp-thread can be varied to suit the strength of the warp; so that the strongest or most delicate yarns can be woven, and a firm or soft fabric produced without any difficulty. This loom performs the whole work of weaving, and will produce a piece of cloth of the ordinary length without the alteration of any of its parts. It has woven two bolts, or thirty yards, of the heaviest sailcloth in twelve and a half hours; and the inventor has stated that he would undertake to do that quantity in less time.—*Durham Chronicle.* **Athenæum, December, 1840.**

Durability of Leather.—Visitors to the Hospital of St. Cross, near Winchester, are shown in the hall two leather stoups or black-jacks for ale, which are, upon pretty good authority, stated to be three hundred years old. Perhaps a more striking proof could hardly be advanced that there really is, for durability, "*nothing like leather.*"

Mechanics' Magazine, November, 1840.

Deposition of Moisture on Metals.—If we place, in an atmosphere saturated with humidity, a piece of polished zinc and a piece of tarnished lead in contact, when the temperature lowers, the lead becomes covered with dew, and the zinc remains dry without oxidising. It is thus with two different metals. The moisture settles on one only. If the effect be attributed to electricity we must conclude that the droplets are electrified positively.—*M. Bonsdorf. Annales des Mines.*

Mining Review, September, 1840.

Meteorological Observations for March, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	31	54	29 78	29.78	W.	Moderate.		Partially cloudy—do do.
	2	36	56	78	.85	W.E.	do		Lightly cloudy—do. do.
	3	34	48	.70	.70	NE.	do.		Cloudy—clear.
	4	34	42	.90	.90	NE	do.		Clear—do
	5	21	32	30 00	30.33	W.	do.		Partially cloudy—do do.
☉	6	25	32	.11	29 80	E.	blustering	2.00	Snow—rain and hail.
	7	36	45	29.32	49	W.	Brisk.		Clear--do. do.
	8	35	41	.54	.60	W.	do.		Cloudy—do.
	9	32	40	30 00	30 13	W.	do.		Lightly cloudy—do. do.
	10	33	36	.00	29 91	E.	blustering	.38	Cloudy--snow.
	11	30	39	29 92	30 00	E.	Brisk.		Lightly cloudy—clear.
	12	26	39	30.13	.05	E.	do.		Lightly cloudy—sleet snow.
☽	13	30	44	29.23	29 30	W.	do.	1.00	Cloudy--flying clouds.
	14	32	41	65	.70	W.	do.		Clear--cloudy.
	15	22	32	30.06	30.15	W.	Moderate.		Clear--do.
	16	29	25	29 90	29.94	E.	Brisk.		Snow—do.
	17	21	28	30 20	30 22	N.	do.		Snow--cloudy.
	18	28	35	29.93	29.88	N.	do.	.60	Cloudy—hail and rain.
	19	33	52	.93	30.00	W.	Moderate.	.28	Clear—do.
	20	34	70	30.00	29.94	W.	do.		Hazy--hazy.
	21	38	56	.01	30.04	W.	Brisk.		Clear—do.
⊗	22	34	54	.24	.20	E.	Moderate.		Hazy--do.
	23	52	60	29 78	29.11	S.	Brisk.		Cloudy—rain.
	24	32	57	.83	87	W.	Moderate.	.33	Clear—do.
	25	37	64	30.00	30 05	W.	do.		Clear—do.
	26	40	69	.10	.00	SW.	Brisk.		Lightly cloudy--hazy.
	27	49	70	29 90	29 90	S	Moderate.		Hazy--do.
	28	47	71	.80	.76	W	do.		Cloudy—do.
☾	29	43	41	.85	60	E	Brisk.	.43	Rain—do.
	30	40	40	.60	.85	W.NE.	Moderate.		Cloudy—do.
	31	26	49	30 20	30.20	E.	do.		Clear--do.
	Mean	34 90	48.80	29.90	29.91			5 02	

	Thermometer.		Barometer.	
Maximum height during the month,	71.	on the 28th.	30.33	on the 5th.
Minimum " "	21.	" 5th and 17th.	29.23	" 13th.
Mean	41.85		29 905	

	Bar[...] Colla[...] old[...] va[...]	9, P.M.	S.W.	W.S.W.	West.	W.N.W.	N.W.	N.N.W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Pl															
2	M	30.01	2⅔	⅓	2⅔	⅓	5⅔	1⅓	.	7⅔	....	.	....	....	.	1290
3	Br															
4	Le	29.94	5	⅓	1⅔	3⅓	5⅓	⅓	.	1⅔	....	.	.....	....	.	1288
5	N															
6	M															
7	Pr	29.48	⅔	⅓	8	.	2⅓	.	.	9	....	.	.....	....	.	1295
8	W															
9	Su															
10	Lu	28.00	6⅔	.	6⅓	1	9⅔	.	.	.	....	.	.....	....	.	1331
11	Sc															
12	Bc	29.35	1⅔	1	6⅔	.	3⅔	⅓	11	⅓	....	.	.....	....	.	1303
13	Cl	29.79	2⅔	.	2	.	18	.	.	.	....	.	......	....	.	1283
14	De															
15	La	29.49	3⅓	4	1	1⅓	6⅔	5	.	⅓	47.25	2	.....	....	.	1297
16	Y	29.40	3⅓	.	3⅔	.	12	.	.	1	40.83	2	......	45.69	2	1307
17	Le															
18	Da															
19	Nc	29.71	.	.	2⅓	.	20⅓	.	.	⅔	....	.	......	....	.	1284
20	Cc	29.39	2	.	7	⅔	4	.	1⅓	.	....	.	.....	48.73	.	1285
21	Br															
22	Ti															
23	Ly															
24	Ur															
25	Mi															
26	Ju															
27	Pe	29.43	1⅓	.	2⅓	.	6	.	14	3	....	.	.....	....	.	1286
28	Cu															
29	Ad															
30	Fr	29.32	2⅓	⅔	5⅓	3	1⅔	⅓	6⅓	½	31.26	6	.....	40.41	6	1373
31	Hu															
32	Ce	29.27	.	.	20⅔	.	.	.	.	1	....	.	.....	....	.	1296
33	Po	29.28	1⅓	⅓	3	.	1	.	1⅓	21	....	.	.....	....	.	1309
34	M'															
35	Cl	27.95	2⅓	.	13	⅓	6⅓	.	.	⅓	....	.	.....	....	.	1301
36	Ca															
37	Be	27.79	⅔	⅓	9	.	.	7	4	3⅓	....	.	.....	....	.	1294
38	So	29.16	3⅔	.	18	.	5	.	.	.	....	.	.. .	....	.	1287
39	In	27.83	4	⅔	8⅓	⅔	1	⅓	9⅓	⅔	....	.	.....	....	.	1308
40	Je	28.54	7⅓	.	8⅔	.	4⅓	.	7⅓	.	....	.	...	....	.	1306
41	W															
42	Ve	28.76	12⅔	1⅓	⅔	.	1⅔	.	9	.	....	.	......	....	.	1299
43	Ar	29.00	1⅔	.	.	.	15⅓	.	.	3⅔	....	.	.....	....	.	1298
44	W															
45	Fa															
46	Gr	28.94	3⅓	.	7⅓	.	4⅓	.	5	⅓	....	.	.....	....	.	1440
47	W															
48	Al															
49	Be	29.21	3⅔	⅓	8⅓	⅔	2	.	8⅓	.	....	.	......	....	.	1292
50	Bu	29.37	5	.	⅓	.	13⅓	.	5	1⅓	....	.	......	....	.	1378
51	M	28.73	8	.	11⅔	.	⅓	.	.	.	....	.	.....	....	.	1293
52	Cr															
53	Er															

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

NOVEMBER, 1840.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.
1	Philadelphia,	Philadelphia,	J. M. Hamilton,	42.70	47.31	45.30	55.00	33.00	45.10	8⅔	20.00	35.11	8
2	Montgomery,												
3	Bucks,	Newtown,	L. H. Parsons,	38.76	48.38	40.30	60.50	28.75	42.48	⅔	24.00	35.87	.
4	Lehigh,												
5	Northampton,	Easton,	Charles Elliot,										
6	Monroe	Stroudsburg,	A. M. Stokes,	33.03	42.48	42.00	60.00	22.00	39.17	11	....	....	.
7	Pike,	Milford,	Ralph Bull,										
8	Wayne,	Honesdale,	W. Richardson,										
9	Susquehanna,	Silver Lake,	E. Rose,	36.50	47.10	40.57	64.00	22.00	41.39	.	18.00	29.20	.
10	Luzerne,	Wilkesbarre,	W. F. Dennis,										
11	Schuylkill,	Port Carbon	P. C. Lyceum,	33.65	50.97	33.03	71.00	24.00	42.55	⅓	22.00	29.80	.
12	Berks,	Reading,	C. F. Egelmann,	38.57	45.97	39.50	58.00	26.00	41.35	.	....	...	.
13	Chester,	West Chester,	Wm. W. Jefferies,										
14	Delaware,	Haverford,	Haverford School,	36.40	44.93	40.60	59.00	27.00	40.64	.	25.00	34.45	1
15	Lancaster,	Lancaster,	Conservatory of Arts,	37.92	47.79	39.98	62.00	29.00	42.56	1	26.00	34.97	.
16	York,												
17	Lebanon,												
18	Dauphin,	Harrisburg,	J. Heisely,	39.90	45.55	42.41	55.00	32.00	42.62	⅔	30.00	37.13	.
19	Northumberland,	Northumberland,	Andrew C. Huston,	35.43	46.27	38.70	57.00	26.00	40.13	.	21.00	30.43	.
20	Columbia,	Danville,	C. H. Frick.										
21	Bradford,												
22	Tioga,												
23	Lycoming,												
24	Union,												
25	Mifflin,												
26	Juniata,	Mifflintown,	J. A. Rinkead,	33.22	48.86	35.76	66.00	24.00	39.28	3	....	....	.
27	Perry,												
28	Cumberland,	Carlisle,	Prof. W. H. Allen,										
29	Adams,	Gettysburg,	Prof. M. Jacobs,	35.88	47.35	38.51	62.00	25.50	40.58	.	25.00	33.59	.
30	Franklin,												
31	Huntingdon,	Huntingdon,	Prof. Jacob Miller,	33.37	46.52	37.80	64.00	22.00	39.23	1	....	....	.
32	Centre,	Bellefonte,	John Harris,	34.11	45.42	36.22	56.00	21.00	38.58	12⅓	....	....	.
33	Potter,												
34	M'Kean,	Smithport,	Richard Chadwick,	29.23	42.80	31.03	64.00	20.00	34.35	.	19.00	27.40	.
35	Clearfield,												
36	Cambria,	Ebensburgh,	Richard Lewis,	29.83	42.09	32.45	76.00	18.00	34.79	2⅔	17.00	27.57	2
37	Bedford,	Bedford,	Samuel Brown,	33.73	46.63	37.12	68.00	24.50	39.16	.	....	....	.
38	Somerset,	Somerset,	George Mowry,	32.00	42.57	35.03	58.00	20.00	36.53	⅔	16.00	28.53	1
39	Indiana,	Indiana,	Richard White,	38.03	45.50	35.30	66.00	20.00	39.61	.	....	....	.
40	Jefferson,	Rose Cottage,	C. C. Gaskell,										
41	Warren,	Warren,	C. S. Brown,	41.33	47.77	46.48	65.00	31.00	45.19	.	31.00	40.70	.
42	Venango,	Franklin,	Wm. Connely,	28.97	44.04	34.96	65.00	13.00	35.99	2	....	....	.
43	Armstrong,												
44	Westmoreland,												
45	Fayette,	Uniontown,	J. P. Weethee,	32.95	47.32	36.22	64.00	18.00	38.83	.	....	....	.
46	Green,												
47	Washington,	Cannonsburg,	Prof. A. H. Campbell,										
48	Alleghany,	Pittsburgh,	J. P. Bakewell,	38.60	46.90	42.20	60.00	30.00	42.57	⅓	....	....	.
49	Beaver,	Beaver,	James Allison,	33.60	47.22	35.80	64.00	21.00	38.87	1	....	....	.
50	Butler,	Butler,	Jacob Mechling,	35.30	44.80	40.20	65.09	21.00	40.30	.	....	....	.
51	Mercer,	West Greenfield,	S. Campbell,										
52	Crawford,	Meadville,	J. Limber,										
53	Erie,	Erie,	Park & Reid,										

	County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1	Philadelphia	29.95	29.96	30.01	30.49	29.60	29.97	8⅓	16	6	8	6	3	....	..	1.960
3	Bucks	29.95	29.90	29.94	30.33	29.50	29.93	⅔	12⅓	15	2⅔	5	1	....	1	3.760
6	Monroe	29.45	29.47	29.48	29.75	29.20	29.47	10⅓	2⅔	11⅓	16	....	....	....	..	......
9	Susquehanna	28.00	27.98	28.00	28.40	27.47	27.99	.	14⅔	15⅓	.	1	2	1	..	0.481
11	Schuylkill	29.33	29.33	29.35	29.96	29.00	29.32	⅓	14⅓	15⅓	⅓	4	3	1	..	3.291
12	Berks	29.79	29.79	29.79	30.19	29.35	29.79	.	11	19	.	3	3	1	1	2.103
14	Delaware	29.51	29.47	29.49	29.90	29.05	29.49	.	14⅔	15⅓	.	5	2	....	..	5.307
15	Lancaster	29.43	29.39	29.40	29.83	28.91	29.41	1	16	13⅔	⅓	10	....	....	..	2.095
18	Dauphin	29.71	29.68	29.71	30.07	29.30	29.70	⅓	.	.	.	5	4	....	..	2.372
19	Northumberland	29.40	29.37	29.39	29.77	28.91	29.39	.	7⅔	22	⅓	5	3	....	..	2.951
26	Juniata	29.46	29.45	29.43	29.84	28.92	29.45	3	10	17	3	3	2	....	..	2.350
29	Adams	29.34	29.31	29.32	29.69	28.81	29.32	.	17	13	.	4	1	....	..	2.185
31	Huntingdon	29.30	29.28	29.27	29.64	28.80	29.28	1	17	13	.	3	4	....	..	......
32	Centre	29.22	29.22	29.28	29.60	28.76	29.24	12⅓	6	11⅓	12⅓	....	....	....	..	......
34	M'Kean	27.97	27.95	27.95	28.30	27.58	27.96	.	8⅓	21⅔	.	4	5	....	..	2.327
36	Cambria	27.79	27.80	27.79	28.13	27.34	27.79	3⅓	9⅔	15⅓	5	2	3	....	..	......
37	Bedford	29.18	29.15	29.16	29.51	28.70	29.16	.	11⅔	18⅓	.	....	....	....	..	......
38	Somerset	27.83	27.84	27.83	28.22	27.40	27.83	½	10⅔	18⅔	⅔	3	6	1	..	1.666
39	Indiana	28.58	28.56	28.54	28.90	28.10	28.56	.	11	18⅔	⅓	9	1	....	..	1.670
41	Warren	28.75	28.74	28.76	29.11	28.40	28.75	.	10⅔	19⅓	.	3	3	1		5.077
42	Venango	29.00	29.00	29.00	29.90	28.48	29.00	5⅓	8⅓	16⅓	5⅓	4	2	....	..	2.805
45	Fayette	28.98	28.98	28.94	29.29	28.29	28.97	.	15	15	.	5	3	....	..	4.703
48	Alleghany	29.21	29.19	29.21	29.55	28.74	29.20	.	10⅔	19	⅓	3	2	....	..	1.256
49	Beaver	29.39	29.35	29.37	29.75	28.82	29.37	1	13⅔	15⅓	1	4	1	1	..	2.410
50	Butler	28.75	28.73	28.73	29.10	28.20	28.74	.	.	.	.	4	4	....	..	2.102

	County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
1	Philadelphia	1⅓	⅓	5	.	⅓	.	1⅔	.	.	⅔	2⅔	⅓	2⅔	⅓	5⅔	1⅓	.	7⅔
3	Bucks	1⅔	⅓	6⅔	2	.	.	⅔	⅓	⅔	.	5	⅓	1⅔	3⅓	5⅓	⅓	.	1⅔
6	Monroe	3⅓	.	2⅓	.	4	.	.	.	.	.	⅔	⅓	8	.	2⅓	.	.	9
9	Susquehanna	4	.	.	.	.	.	1⅓	.	1	.	6⅔	.	6⅓	1	9⅔	.	.	.
11	Schuylkill	1⅓	.	1	.	2	⅓	⅔	.	⅓	.	1⅔	1	6⅔	.	3⅔	⅓	11	⅓
12	Berks	2	.	1⅔	.	2	.	1⅓	.	⅓	.	2⅔	.	2	.	18	.	.	.
14	Delaware	1⅓	2	2	1⅓	.	.	⅓	⅓	.	1⅓	3⅓	4	1	1⅓	6⅔	5	.	⅓
15	Lancaster	4	.	2	.	2	.	1⅔	.	⅓	.	3⅓	.	3⅔	.	12	.	.	1
18	Dauphin	3⅓	.	⅔	.	.	.	2⅓	.	⅓	.	.	.	2⅓	.	20⅓	.	.	⅔
19	Northumberland	4	.	3	.	3⅓	.	3⅓	.	1	.	2	.	7	⅔	4	.	1⅓	.
26	Juniata	⅓	.	⅔	.	.	.	2	.	⅓	.	1⅓	.	2⅓	.	6	.	14	3
29	Adams	4⅔	1⅓	⅓	.	⅓	.	.	⅔	1⅔	1	2⅓	⅔	5⅓	3	1⅔	⅓	6⅓	⅓
31	Huntingdon	.	.	.	.	8⅓	.	.	.	.	.	.	.	20⅔	.	.	.	.	1
32	Centre	⅓	⅓	.	.	1⅓	.	.	.	.	.	1⅓	⅓	3	.	1	.	1⅓	21
34	M'Kean	1	.	.	.	4⅓	.	2⅓	.	.	.	2⅓	.	13	⅓	6⅓	.	.	⅓
36	Cambria	.	.	⅔	⅓	1	.	2⅓	.	⅔	.	⅔	½	9	.	.	7	4	3⅓
37	Bedford	⅓	.	.	.	.	.	.	.	3	.	3⅔	.	18	.	5	.	.	.
38	Somerset	1⅓	.	⅓	.	⅔	.	2	.	⅔	.	4	⅔	8⅓	⅔	1	⅓	9⅓	⅔
39	Indiana	⅓	.	.	.	⅓	.	⅔	.	1	.	7⅓	.	8⅔	.	4⅓	.	7⅓	.
41	Warren	⅔	.	.	.	.	.	2⅔	⅔	⅓	⅓	12⅔	1⅓	⅔	.	1⅔	.	9	.
42	Venango	.	.	.	.	.	.	9⅓	.	.	.	1⅔	.	.	.	15⅓	.	.	3⅔
45	Fayette	⅓	.	⅓	.	.	.	3⅓	.	⅔	.	3⅓	.	7⅓	.	4⅓	.	5	⅓
48	Alleghany	.	.	.	.	3⅓	.	⅓	.	3	.	3⅔	⅓	8⅓	⅔	2	.	8⅓	.
49	Beaver	.	.	1	⅔	.	.	3	.	⅓	.	5	.	⅓	.	13⅓	.	5	1⅓
50	Butler	.	.	⅔	.	7⅔	.	.	.	1⅔	.	8	.	11⅔	.	⅓	.	.	.

	County.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Philadelphia	....	.	.....	....	.	1290
3	Bucks	....	.	.....	....	.	1288
6	Monroe	....	.	.....	....	.	1295
9	Susquehanna	....	.	.....	....	.	1331
11	Schuylkill	....	.	.....	....	.	1303
12	Berks	....	.	......	....	.	1283
14	Delaware	47.25	2	.....	....	.	1297
15	Lancaster	40.83	2	......	45.69	2	1307
18	Dauphin	....	.	.....	....	.	1284
19	Northumberland	....	.	.....	48.73	.	1285
26	Juniata	....	.	.....	....	.	1286
29	Adams	31.26	6	.....	40.41	6	1373
31	Huntingdon	....	.	.....	....	.	1296
32	Centre	....	.	.....	....	.	1309
34	M'Kean	....	.	.....	....	.	1301
36	Cambria	....	.	.....	....	.	1294
37	Bedford	....	.	.. .	....	.	1287
38	Somerset	....	.	.....	....	.	1308
39	Indiana	....	.	...	....	.	1306
41	Warren	....	.	......	....	.	1299
42	Venango	....	.	.....	....	.	1298
45	Fayette	....	.	......	....	.	1440
48	Alleghany	....	.	......	....	.	1292
49	Beaver	....	.	......	....	.	1378
50	Butler	....	.	......	....	.	1293

JOURNAL

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Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 299.]

8. *On the number and form of the buckets of an overshot wheel.*—The question of the relative value of elbow and centre buckets has been already examined (p. 221) by experiments made upon the high overshot wheel No. I. The convenient size of wheel No. IV induced the committee to use it in the more extended examination of questions in reference to the number and form of buckets. The number of elbow buckets applied to it was changed from twenty to forty, and oblique buckets, as well as curved buckets, of two different forms, were experimented with. The forms and other particulars relating to these buckets are given in a former part of this report (Jour. Frank. Inst., vol. x, p. 297, Plate VIII.)

A comparison of the ratios of effect to power, and of the velocities with wheel No. IV, with twenty and with forty elbow buckets, is given in the annexed table taken from tables 1 and 2 (vol x., pp. 298 302, Jour. Frank. Inst.)

TABLE TWENTY-FOURTH.

Comparison of overshot wheel No. IV, with twenty and with forty elbow buckets.

Head above gate.	Width of aperture.	Table 1, forty buckets.		Table 2, twenty buckets.		Table 1, forty buckets.		Table 2, twenty buckets.	
		Ratio of effect to power.	Mean ratio.	Ratio of effect to power.	Mean ratio.	Velocity of wheel.	Mean velocity.	Velocity of wheel.	Mean velocity.
Feet.	Inches.					Feet.	Feet.	Feet.	Feet.
0.25	0.50	.911		.867		5.94		5.86	
"	0.75			.824				5.78	
"	1.00	.852		.750		5.29		5.71	
"	1.25	.833				5.22			
"	1.50	.798		.739		6.29		5.71	
"	1.75	.731	.825		.795	5.49	5.65		5.76
0.75	0.38	.795		.842		5.03		5.94	
"	0.50			.800				5.86	
"	0.75	.801				5.57			
"	1.00	.755				5.35			
"	1.25	.748	.775		.821	5.49	5.36		5.90
		Mean	.800		.808		5.50		5.83

The average of the ratios of effect to power is nearly identical in the two cases, and the velocities are in the ratio of one to 1.06.

In the individual experiments the advantage is sometimes in favour of one set and sometimes of the other. It seems then that there was no advantage gained by increasing the number of elbow buckets upon this wheel, the original number being twenty, and the space occupied upon the soling, in the clear, by each bucket being about eight and a half inches, or from centre to centre an arc of eighteen degrees.

In the annexed table the ratios of effect to power and the velocities of wheel No. IV are compared when it was furnished with forty elbow buckets and with thirty inclined buckets. The deductions for the forty elbow buckets are taken for comparison, because the results are more numerous than those with the twenty buckets. Experiments are taken, in which all the circumstances were the same, and which corresponded to maximum ratios of effect to power.

TABLE TWENTY-FIFTH.

Comparison of elbow buckets with inclined buckets. Overshot No. IV.

Head above gate.	Width of aperture.	Elbow buckts. table 1.		Inclined buckets table 3.		Elbow buckets, table 1.		Inclined buckets, table 3.	
		Ratio of effect to power.	Mean ratio.	Ratio of effect to power.	Mean ratio.	Velocity of wheel.	Mean velocity.	Velocity of wheel.	Mean velocity.
Feet.	Inches.					Feet.	Feet.	Feet.	Feet.
0.25	1.00	.852		.808		5.29		4.57	
"	1.25	.833		.781		5.22		4.34	
"	1.50	.798		.803		6.29		3.97	
"	1.75	.731	.803	.772	.791	5.49	5.57	3.81	4.17
0.75	0.75	.801		.770		5.57		3.25	
"	1.00	.755		.777		5.35		2.97	
"	1.25	.748	.768	.763	.770	5.49	5.47	3.61	3.28

As in the last comparison, the *ratio of effect to power with the two varieties of buckets appears to be the same*, but there is a *great falling off in the velocity of the wheel by the use of the inclined buckets.* Some of the experiments taken as corresponding to maxima do not appear, from an inspection of the table, to fulfil the condition of true maxima, but others are unexceptionable, and as all show the same falling off in the rate of motion of the wheel, it must be taken as proved.

The explanation of this fact is, probably, to be found in the more or less favorable direction in which the water strikes the wheel. An inspection of fig. 3, Plate VIII, (vol. x, p. 296, Jour. Frank. Inst.) and a comparison with fig. 1, of the same plate, will show that the direction of the oblique buckets was much less favorable to a transfer of the force of the impinging water in the direction of the motion of the wheel. As it appears that the velocity of the impinging water is the circumstance which determines the velocity of the wheel, it might be concluded that any difference in the force with which, or the mode in which, the water strikes the wheel will produce a change in the velocity of the latter. Hence a change in the form of the buckets of the wheel, or in the form of the gate, where the chute is not of considerable length, will affect this velocity. This is probably the physical explanation of some of the difficulties heretofore stated in the conclusions in reference to the velocity of the wheel. Before passing these in review, we propose to examine the relative value of elbow and curved buckets; the effect of the use of these latter in the wheel will strengthen the conclusions in reference to the oblique buckets.

A comparison of the same elbow buckets with the curved buckets

before referred to is accordingly given below. It will be recollected that the second variety of these buckets was formed by cutting away a portion of the extremities of the first. The table referring to these (vol. x, p. 370, Jour. Frank. Inst.) shows no proper maximum, but the experiment giving the greatest ratio of effect to power has been taken for comparison.

TABLE TWENTY-SIXTH.

Comparison of the elbow and curved buckets. Overshot No. IV.

	Ratios of effect to power.			Velocities of wheel.		
Feet.	Elbow buckets, table 2.	Curved buckets, table 4.	Curved buckets, table 5.	Elbow buckets, table 2. Feet.	Curved buckets, table 4, Feet.	Curved buckets, table 5. Feet.
0.25	.795	.766		5.77	4.36	
0.42			.793			3.36
0.75	.821			5.90		
1.75		.678			4.04	
2.75	.645			6.65		

The comparison of the two varieties of curved buckets was in a degree vitiated by the removal of the wheel from the breast, in the experiments recorded in table 5, but the conclusion is fully warranted by the experiments from table 4, that in regard to the *ratio of effect to power the curved buckets are nearly equal to the elbow buckets, while in reference to the velocity of the wheel they are much inferior to them*, when the water is delivered as in these experiments. The velocities of the wheel with the two kinds of elbow buckets, with the first form of curved buckets, and with the oblique buckets, were at a mean as 5.6 to 4.2, and 3.7.

The reason assigned for the reduction of the velocity by the use of the oblique or of the curved buckets would, if correct, render it probable that with the mode of delivering water to the wheel adopted in the experiments there would be a gain in the velocity of the wheel, used as an overshot wheel, by employing centre buckets. Accordingly it will be found, by referring to page 222, that the average increase in the velocity of the wheel, under various heads, was about five per cent.

Again, the application of the same principles satisfactorily explains why it was found in tables fourth and fifth (pages 147–8) that the velocity of the wheel differed when the different gates *a*, *b*, and *c*, were used to deliver the water; being on the average in the proportion of 1.115, to 1.305, and 1.245 for the three gates respectively. The examinations of the quantities of water discharged by the three gates, made in table eighth, (page 151,) and again in table thirteenth (page 219) showed that *b* and *c* acted, in fact, as adjutages in modifying

the flow of water from them, the increase in the quantity of discharge being attended with a decrease in the actual velocity of the water delivered to the wheel, from an increase in the real area of discharge by the aperture acting in part as an adjutage. The velocity calculated from the quantity discharged is thus greater than the actual velocity. Hence while the actual velocity of the wheel is increased by the more favorable direction in which *b* and *c* delivered the water to it, the velocity of the water calculated from the quantity discharged by the same gates is apparently increased also, and the ratio of the velocity of the wheel to the velocity of the water appears correctly, at a mean, as shown by table tenth (page 153,) to be constant.

A further confirmation of these views will be found in the experiments to be referred to subsequently, on the comparison of the mode of admitting water to the buckets of an overshot wheel through a chute and by drawing it from the surface of the forebay.

Many difficulties in relation to the variations in the velocity of the wheel, are thus satisfactorily cleared up by reference to a physical cause, which is adequate to explain them, and the mode of operation of which may be readily estimated, though all the attending circumstances are not sufficiently well known to admit of calculation. We are inclined to refer to this same cause the unexplained, but sufficiently well established, effect of variations in the quantity of water supplied to the wheel, that is in the aperture of discharge, (pp. 217–8) upon its velocity. Thus, in theory, the two practical conclusions from the experiments, the first referring to the effect of an increase of quantity and the second to the effect of a change in the form of the gate would be referred to one cause, the same, also, in fact which produces a change in the velocity of the wheel by a change in the form of buckets.

The conclusion is fully warranted, from these comparisons, that in any circumstances not included within the range of these experiments, in which the velocity of the water, or the mode of its transmission to the wheel, should be changed, a corresponding change would take place in the velocity of the wheel.

9. *Comparison of the mode of admitting water to an overshot wheel through a chute, or by drawing it directly from the surface.* The mode of making this comparison is fully detailed in the introduction to the tables relating to wheel No. IV, (Jour. Frank. Inst. vol. x, p. 296.) The sudden falling away of the ratios when the latter mode of admitting water was adopted, leaving no room to doubt in reference to the result, notwithstanding that no maximum is shown in either case by the table, (No. 5, parts 1 and 2.)

TABLE TWENTY-SEVENTH.

Comparison of the mode of supplying water to an overshot wheel through a chute, and by drawing it from the surface. Wheel No. IV.

Table 5. Parts 1 and 2.	Head above gate.	Head and fall.	Velocity of wheel.	Ratio of effect to power.
	Feet.	Feet.	Feet per second.	
Chute, ...	0.42	6.67	3.36	.793
From surface, .	0.23*	6.67	3.06	.606

* In the table this is erroneously given as 2.75 feet. It should be 2.75 inches.

The proportion of the ratios in the two cases is as .793 to .606, or as 1.31 to 1.00, and the velocities bear the ratios of 1.1 to 1. The result in reference to the velocities confirms the general conclusions before referred to, (page 365.)

10. *Delivery of the water to the wheel through two gates acting in succession.*—It is easy to see that the admission of water through two gates acting in succession may be advantageous, when owing to the construction of the buckets or the large quantity of water admitted to the wheel, the water does not enter the buckets readily, but meets with considerable impediment in its passage to the lowest part of the buckets. When the buckets are constructed with due reference to the quantity of water to be received by them, it does not appear probable that two gates acting successively can have any particular advantage over one. Experiments upon this subject were made with wheel No. III, the arrangements in reference to which are described in a former part of this report, (Jour. Frank. Inst., vol. x, p. 11, Plate VII.) The experiments which are most directly comparable are collected in the following table.

TABLE TWENTY-EIGHTH.

Comparison of the effects of a single gate delivering water to an overshot wheel, with two gates acting in succession. From table I, parts 2 and 3, and from table II, parts 1 and 2. Overshot No. III.

Head above bottom of gate.	Head and fall.	Aperture. a.	Aperture. b.	Ratio of effect to power. One aperture.	Ratio of effect to power. Two apertures.
Feet.	Feet.	Inches.	Inches.		
2.75	13.00		1.00	.689	
"	"	0.50	0.50		.724
3.75	14.00		0.62½	.631	
"	"	0.37½	0.25		.658
0.25	10.50	1.50		.669	
"	"		1.50	.670	
"	"	0.75	0.75		.692
0.75	11.00		1.50	.780	
"	"	0.75	0.75		.758
1.75	12.00		1.00	.726	
"	"	0.50	0.50		.754
2.75	13.00		1.00	.668	
"	"	0.50	0.50		.702
3.75	14.00	0.75		.654	
"	"		0.75	.604	
"	"	0.37½	0.37½		.678
			Mean	.677	.709

The reasons why the ratios of effect to power contained in this table fall short of those formerly commented upon are that the heads above the gate in the former part of the table have a considerable proportion to the head and fall, and that in the experiments contained in the latter part no breast was used. A reference to the individual experiments shows some uncertainty as to whether the ratios actually represent maximum effects or not, but in the advanced stage of the experiments at which these results were obtained, an experiment which did not promise well was frequently not continued to its close, and hence these conclusions are probably near the truth.

The average ratios with the single aperture and with the two acting successively appear to be .677 and .709, being in favour of the latter; the proportion is as one to 1.047 nearly. The average velocities in the two cases are more nearly equal, being 6.19 and 6.42, or in the proportion of 1 to 1.037.

11. *On the use of a breast with an overshot wheel.*—Experiments for comparing the results with an overshot wheel and elbow buckets used with a close breast and without a breast, were made with wheel No. III, and are contained in tables I and II referring to that wheel, (Jour. Frank. Inst., vol. x, pp. 12–16.) In the following table the conclusions are brought together. The part above the first line which gives a mean of the results, contains experiments made under precisely similar circumstances, except in reference to the breast, and the first and second columns of the table point out the experiments in tables I and II from which the numbers for the velocities of the wheel, and for the ratios of effect to power, have been obtained. In the part of the table below the first line of mean results, the averages of all the highest results under each head, with and without a breast, are given, bringing a greater number of experiments to bear upon the conclusion, but comparing these not alike in the circumstances of the aperture by which the water was admitted to the wheel.

TABLE TWENTY-NINTH.

Comparison of the results with overshot wheel No. III, with and without a breast.

Table I.	Table II.	Head above gate.	Head and fall.	Velocity of wheel.		Ratio of effect to power.	
				With breast.	Without breast.	With breast.	Without breast.
No. of the experiment.		Feet.	Feet.	Feet.	Feet.	Power = 1.	
3	1 & 4	0.25	10.5	4.52	4.40	.817	.670
8	10	0.75	11.0	5.20	5.51	.809	.780
13	15	1.75	12.0	5.94	5.78	.758	.726
16 & 34	18 & 19	2.75	13.0	6.65	6.86	.706	.685
40 & 49	21 & 31	3.75	14.0	7.39	6.80	.664	.627
		Mean		5.94	5.87	.751	.698
No. of maximum.							
1	3	0.25	10.5	4.52	4.20	.817	.677
1	2	0.75	11.0	5.20	5.72	.809	.769
1	2	1.75	12.0	5.94	5.61	.758	.740
5	2	2.75	13.0	7.08	6.86	.711	.685
5	6	3.75	14.0	7.22	7.29	.666	.657
		Mean		5.99	5.94	.752	.706

The mean of the several results obtained by the two methods just explained does not differ materially, particularly the mean of the ratios of effect to power, which appears to be in favour of the use of the breast in the proportion of .751 to .702, or of 1.06 to 1.00, under

the average of heads from 0.25 to 3.75 feet, and of head and fall from 10.5 to 14.0 feet. The velocity of the wheel being determined by that of the water impinging upon it does not differ in the two cases in question.

[TO BE CONTINUED.]

Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 319.]

[Translated for the Journal of the Franklin Institute.]

15. *The Land Surveyor's Square.* This instrument resembles the head of a cane, (fig. 17,) in which is cut two rectangular vertical openings A C D G, O F E I, which serve as sights. The lower part of these openings is cut in the form of a window, and to direct them towards a signal, the eye is applied to the opposite slit. In the bottom of this head is a socket which receives the head of a staff and retains it there by friction. The extremity of the staff is shod with iron. To use this instrument, plant the staff vertically in the ground, and turn the square on its socket until one of the slits is on a line with some distant signal. Then without moving the instrument, place the eye at the other slit and have a signal put up on its prolongation. Thus a second line will be obtained perpendicular to the first. When the ground is rocky, a tripod is used instead of the single or jacob staff.

The land surveyor's square is used to trace on the ground, lines at right angles to each other; it can also be used to determine the area of pieces of ground. This is done in the following manner.

Suppose figure 20, Plate II, to represent the outline of the ground to be surveyed; go to different points in succession along the line A B, and find the places D, F, H, where if the instrument is placed, one of the sights will be directed along the line A B, while the other is directed on the respective angles or corners C, E, G, which limit the outline of the field. If this outline is a curve, it must be so divided into parts, that each may be regarded as a straight line. Place a signal at each station, D, F, H, and also at the angles C, E, G, and measure the lengths, A D, D F, F H, H B, and also that of the perpendiculars, C D, E F, G H. We have then all that is necessary to plot the outline and calculate the area.

For example:—Trace on the paper any indefinite right line *a b;* lay off on it with the dividers the distances *a d*, *d f*, &c. taken from the scale, which represent the distances measured on A B; then at

each division erect the perpendiculars, *d c*, *f e*, *h g*, also taken from the scale; the number of parts, in each case, taken on the scale, being the number of units, the lines measured on the ground. To get the figure *c a e b g*, nothing remains but to join the extremities of the perpendiculars by right lines. It is evident this plan is reduced to a horizontal plane, since all the distances measured were horizontal. If the object is to know the length of the sides and the angles of the polygon, they can be ascertained by the aid of the scale and the protractor.

This operation is intelligible to the most ordinary capacity; and hence the surveyor's square is in continual use; besides, it gives immediate results, as it is only necessary to calculate the trapeziums and triangles, into which the ground is divided.

When the field is not bounded by a right line, we take as a base a right line which traverses the field, and stake it out with signals. (Fig. 21.) The distances intercepted on the boundary, by perpendiculars from these signals, being assumed as right lines, the boundary is determined.

In this manner, the sinuosities of roads, streams, enclosures, &c., can be determined. But the inequalities of the ground, the difficulty of measuring horizontal distances, and the obstacles which intercept the view, added to the slowness of the operation, frequently make it necessary to use some other instrument.

The head of the land surveyor's square is generally made in an octagonal form, and with slits so cut as to make with each other angles of 45°. These are used on the same principle as those of 90°. To test the correctness of these angles, look through the sights, and place a signal in the direction of each, then turn the square on its socket until the adjacent sights are on a line with the signal, which the first sights covered; if the instrument is correct, the sights first looked through will then be in exact co-incidence with the next signal, &c.

16. *The Pantometer of M. Fouquier.* This instrument is an improvement on the square, (fig. 23, Plate II,) and is formed of a cylinder cut in two parts; the lower one, A B C D, is secured to a staff by the socket K, and the clamp screw P; the upper part E F G H, turns on an axis concentric with the first, so that the divisions traced on the edge E F, pass along those on the lower border C D. The fixed circumference is divided into degrees, and the arc passed over by the upper cylinder is given at *n*. The vernier *m* gives the fractional part of the degree. A slit is cut in the fixed cylinder at *a*, and another diametrically opposite at *b*, through the middle of which a horsehair is stretched vertically. The upper cylinder also has two

slits at *d* and *c*, the last of which is also furnished with a horsehair. Care must be taken that these sights, in both cylinders, correspond exactly with the zero points on the graduation of the lower limb and the zero point on the vernier. This is ascertained by placing the two zeros in coincidence, and looking at a signal.

The manner of using this instrument is very easy to understand. The two movements which the instrument has, namely, that of both the cylinders about the socket, and that of the upper cylinder about its axis, enable the observer to fix the lower sights on one signal, while those of the upper are directed towards another signal. The angle made by two visual rays, drawn through these sights from the point where the instrument stands, to the signal, is given on the circle C D, and the vernier *m*. This then is one means of measuring angles, and the use of the instrument in plotting will be seen in the article on the graphometer.

A compass is usually fixed on the top G H, by the aid of which, objects are laid down where obstacles interpose to obstruct the view. A spirit level is also attached, to enable the operator to place the axis of the instrument vertical.*

17. *The Graphometer.* This instrument is used to measure angles. It is formed like a graduated semicircular protractor, from 4 to 10 inches or more in diameter, furnished with alidades and mounted on a universal joint, such as has been described already, (No. 12.)

Perpendicular to the limb and near its periphery are placed two sights P, P, opposite each other. The plane which passes through these sights is perpendicular to the limb, and lies on the diameter marked zero and 180°. Another alidade L L, moves round the centre C, and, in all its positions, along the limb, in the direction of its radii. These sights are nearer to the centre than the others, and when the alidade is directed along the principal diameter, the hairs of the four sights should coincide, upon the eye being applied at the extremity. This alidade carries a vernier which enables the observer to read the fractional parts of a minute.

It is necessary that the centre of the graduated arc should be the axis of rotation, in order that the line of the fixed sights correspond with the diameter of zero and 180°, and that the line of sight of the movable sights also pass through the centre. These conditions being fulfilled, an angle is measured in the following manner. Turn the instrument in its socket, until the radius marked zero is directed on a signal; clamp the instrument and turn the alidade until the line of sight is directed on another signal. As it is difficult with the hand

* It is hardly necessary to observe that all the operations of the Land Surveyor's Square and Pantometer may be performed by any instrument capable of measuring angles.

to place the line of sight of the alidade exactly on an object, the tangent screw is used to complete the operation.

The universal joint is so constructed, that the plane of the limb can be made to assume a vertical position, the correctness of which is tested by a plumb line. The limb can also be made horizontal, for which purpose, two spirit levels n, n', are placed upon it, at right angles to each other. In this last case, the angle measured is that formed by the visual rays to the two objects, reduced to the horizon (fig. 22); in the other, the angle measured is vertical, and is the angular height of one point above another: and if the principal diameter is horizontal, which is ascertained by the spirit level, the angle is the angular height of the point above the horizon.

The graphometer is also furnished with a small compass, the north and south line or diameter of which is graduated 0° and 180°, and is parallel with the diameter of the limb. It serves to lay down on a map the magnetic meridian, and to direct the sights towards invisible objects, as will be described in the article on the compass.

The spirit levels and the compass are fixed on in such a manner as not to interfere with the movements of the alidade or the universal joint.

After moving the revolving alidade, care must be taken to look again through the fixed sights, to be assured that the instrument has not been moved; as it frequently happens, that the force applied to move the alidade, moves also the whole instrument, making it necessary to readjust the hair of the fixed sights upon the signal.

For the purpose of seeing objects at a distance, telescopes furnished with an object and eye-glass, are used in place of the sights. At the common focus of the two glasses, are two hairs at right angles to each other, one parallel and the other perpendicular, to the limb.

The fixed telescope is placed under the limb; the movable one above it. Their axes should correspond respectively with the zero points of the limb and the vernier. For the purpose of seeing objects not in the plane of the limb, each telescope is mounted on a shaft perpendicular to the limb, and has a limited vertical motion. To ascertain if the axes of the sights or of the telescopes are properly adjusted, direct both to the same distant object, and see if the zero of the vernier coincides with the zero of the limb. When it does not, there is an error of collimation, the value of which is the difference between the two zeros, and is a constant quantity which it is necessary to add to or subtract from the observed angle as the case may be. It is better, however, to destroy the error by moving the hairs. For this purpose, the hairs have a transversal motion given to them by the aid of lateral screws. A screw is also used to

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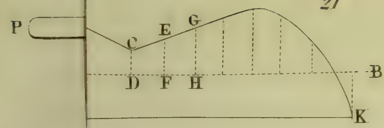

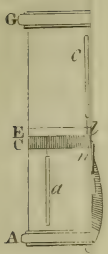

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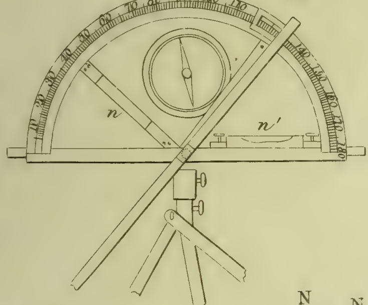

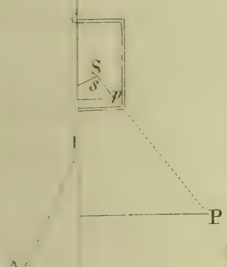

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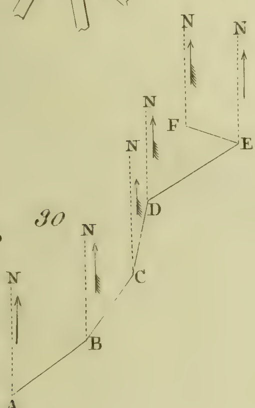

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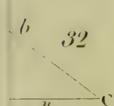

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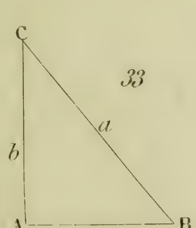

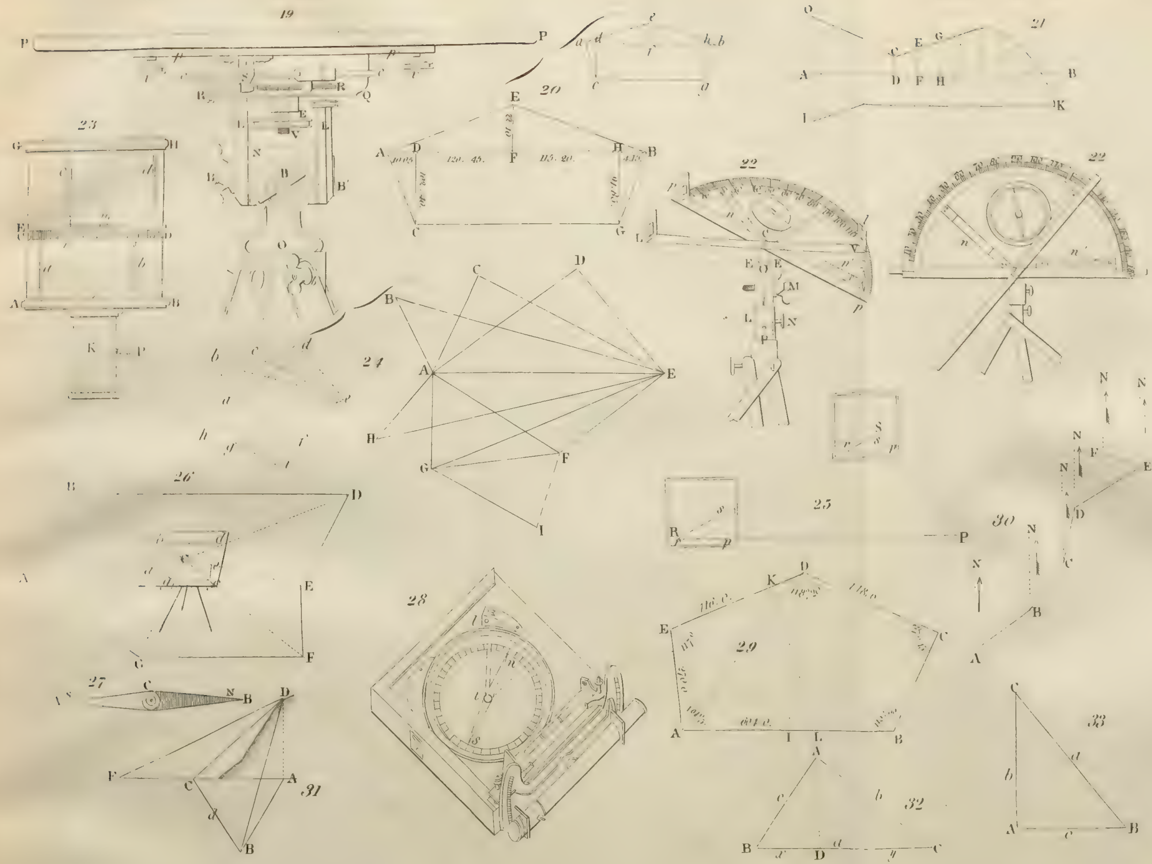
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give a motion along the axis of the telescope, to place them in the focus of the object-glass. The telescopes just described reverse objects; but no inconvenience results on this account.

For the purpose of discovering if the instrument is well centered and well divided, measure the angle formed by lines drawn from a station to two signals, by referring them to a third signal; the angle sought is either the sum, or the difference of the two angles measured. This done, change the position of the third signal, and the same operation should give the same result. Another mode is by measuring the three angles of a triangle, the sum of which should make 180°.

The Graphometer is used in many topographical operations, but it will be sufficient to describe the manner of projecting plans with it. Let A B C D E (fig. 24) be different objects situated in a country of which we wish to get the plan. Measure the length of a horizontal base A E, the position of which is so chosen that all or most of the objects can be seen from the extremities A and E, and that the angles subtended shall be neither too obtuse nor too acute, &c.

Then station the instrument at A, and measure all the angles included between the base line A E, and lines drawn to the other points; these angles are reduced to the horizon when the plane of the limb at the time of the observation is fixed horizontally; by this means we know the angles B A E, C A E, D A E, H A E, &c. This being done, remove the instrument to E, and measure the angles D E A, C E A, B E A, F E A, &c.* To avoid confusion, the values of all these angles should be recorded on a sketch, representing the objects in the order they were seen.

To plot the above, draw on paper a right line *a e*, equal in length to as many parts of the assumed scale, as there are parts in yards or feet, &c., found in the base line by measurement. From the point *a*, with the aid of the protractor or other instrument, (see No. 4,) draw the right lines *a b*, *a c*, *a e*, *a f*, &c., making angles with the base respectively equal to the angles observed at A; then from the point *e*, draw lines *e d*, *e c*, *e b*, *e f*, making with *a e*, angles equal to those observed at E. These lines will cut those first drawn at the points *b*, *c*, *d*, *f*, &c., shewing the positions of the several observed signals B, C, D, &c.

It may be proper to remark that with the aid of dividers and scale, the lengths A B, B C, C D, D E, &c., can be ascertained on the plot, although they were not actually measured. Moreover, if any object is invisible from one or both of the stations, the place it occupies on

* As a confirmation or correction, take some intermediate known point on the base and go through the same operation. Each required point will then be determined by the intersection of three lines.

the plot can be ascertained, by taking as a base the distance between any two other stations from which it can be seen; for example, the point I, visible from G and from F, is found by measuring the angles, I G F, I F G.

The Graphometer serves, as before shewn, to find the distance between objects which are inaccessible. It will soon appear, that it can be used to find the height of signals above the horizon. But as these propositions involve the resolution of problems in right line trigonometry, they will be treated of hereafter, (No. 45.)

The method of intersections just described, saves much time and labour; but it is attended with the objection that it may be necessary to use angles that are very acute or very obtuse, which gives erroneous results. In this case it is best to make as many stations as there are signals, on the boundary of the locality to be surveyed, and measure the distance between the consecutive signals and the angles at each. Fig. 29 gives an example of this method, a more minute description of which is unnecessary here, as it will be found in the article on the plane table.

The repeating circle and the theodolite, which will soon be described, are also used like the graphometer to measure angles; but the complication of these instruments, the time it takes to adjust them and to make the observations, &c., prevent them from being used except in cases which require an extreme degree of precision, such as is seldom required in the details of topography. The sextant and the reflecting circle described in the treatise on navigation can be very conveniently used in measuring angles, more so than even the graphometer; but they give the true and not the projected angle.

[TO BE CONTINUED.]

Arching of Tunnels through Friable Rocks. By ELLWOOD MORRIS, *Civil Engineer.*

Where tunnels are cut through a material firm enough to sustain itself during the process of excavation, but not sufficiently solid to answer subsequently, without the protection afforded by an arch; economy and convenience usually require that the whole or nearly all of the excavation should be completed before the arching is taken in hand: for the darkness and contracted space in tunnels, render it quite difficult to work, advantageously, gangs of men employed at the same time, in two such different operations; the miners blasting and moving out material, and the bricklayers bringing in their bricks and mortar, all by the same railroad (unless two tracks are laid) produce interferences, the one with the other, which are found in practice to

be prejudicial to a just economy in execution, and often may require a longer time for the accomplishment of both, than if the labour was divided and each advanced independently.

Hence in tunnels through friable rocks it is usual, firstly, to perforate the hill and trim out the transverse section; secondly, to turn and pack the arch; thus dividing the construction into two distinct operations.

So much time is commonly consumed in the tedious process of tunneling that such works are almost invariably driven both day and night; and the excavation being accomplished, it will generally be necessary (in order not to detain the opening of the work for use) to press the arching forward with the utmost expedition: to do which requires some ingenuity in arranging the work and stationing the workmen, so as to be enabled to employ in the tunnel a powerful force; and this will be found impracticable in such confined situations, without peculiar arrangements different from what would be adopted in works in the open air.

The longest tunnel in America—that of the Chesapeake and Ohio Canal at the Pawpaw bend of the Potomac river—being 3,118 feet in length between its portals; is cut through a slate rock of such character that a thorough arch is indispensable to the safe and uninterrupted transit of boats: but the roof of rock being sufficiently firm to sustain the mass of the hill above, whilst it is not enough so to prevent continual and heavy scaling from the soffit, a light arch, *well packed*, has been designed to keep the material in place and make the roof safe; the side walls or abutments to be thirteen inches, or a brick and a half, and the arch nine inches, or one brick, in thickness; its span being twenty-four feet, and its intrados a semicircle.

This tunnel having been carried on with the intention of nearly completing the excavation before commencing the arch, and that part of the work being nearly done, it became the duty of the writer to devise the means of inserting this arch, with the least possible delay; and as it pertains to a subject of professional importance, an extract will be given from a late report to the Directory of the Chesapeake and Ohio Canal Company, with the hope that it may induce some of the writer's professional brethren to communicate their observations upon kindred subjects, through the pages of this Journal, which it affords the Committee on Publications great pleasure to open for the purpose of bringing forward their experience and views upon this or other matters of engineering.

Extract from a Report made to the President and Directors of the Chesapeake and Ohio Canal Company, by ELLWOOD MORRIS, *Chief Engineer, December* 31*st*, 1840.

As it has been imagined by some that the arching of the tunnel would require a very long time, it may be as well to give an outline of the plan upon which I have long contemplated proceeding with this portion of the work; and by the execution of which I have entire confidence that, with a heavy force, this formidable arch, though 3,118 feet long, and requiring about 3,500,000 bricks, can be constructed in a single year: the bricks being prepared beforehand and delivered at the portals.

By the experiment of Col. Pasley, of the Royal Engineers, of Mr. Brunel and others, the cohesive power of cement has been demonstrated to be so great, that from twenty to thirty bricks, with their longest dimensions vertical, had been stuck out horizontally from a wall, by adding successively a brick at a time, as soon as the cement joint of the preceding one had set.

Acting upon the principle of cohesiveness here developed; possessed, as it is in an eminent degree, by the hydraulic cement of the Potomac, which I contemplate using in the arch, at least without any admixture of sand, in order to procure a quicker set and firmer bond, I propose:

1. With a strong force to raise both side walls up to the springing line of the arch.

2. In sections of, say 500 feet, by reverse moulds and without centering, to carry up the arch on both sides to the angle of repose; and bringing into play the coherence of the cement, even above it, say to an angle of forty or even forty-five degrees, as may be determined at the time.

3. By a system of detached centres, framed to leave open about thirty degrees of the crown, each supporting three feet lineal of the arch, and leaving an interval of four or more feet to be sustained by the cohesive power of the cement, to carry up the spandrels of the arch to an angle of seventy-five degrees or within fifteen degrees of the crown on each side.

4. By a very light centre, (capable of being handled by two men,) to key up the crown in sections of two feet, shifting the crown centre continually, (upon a platform carried by the detached system,) as each successive section of the crown is keyed up and packed.

Those who are conversant with practical affairs, will at once perceive that, by working in long sections, course by course successively, the cement will set in one part whilst the workmen are engaged at

another; and that by the division of labour indicated in the above outline, a very large force can be employed upon the arch, and so organized as to finish each part in detail; the most tedious portion, that of keying up, being limited by the mode of operation, to thirty degrees of the crown alone, or but one-sixth of the semi-circle, can be advanced by working only from a single point, at the rate of ten feet lineal per day.

Oldtown, Md., April 18th, 1841.

Extracts from the Report of M. R. Stealey, *Resident Engineer of the Kentucky River Navigation, to* Sylvester Welch, Esq., *Chief Engineer of Kentucky. Dated Frankfort, December* 1, 1840.

"Notwithstanding the extraordinary efforts which were made in the fall of 1839, and continued through the winter, it was found impracticable to complete locks, and dams Nos. 2, 3 and 4, before the winter freshets occurred. The lock walls were not carried up to their full height—the machinery for working the gates was only temporarily and partially attached—the covering of the dams was incomplete—the approaches to the locks not fully formed—and the banks were in a degree unprotected from abrasion by the floods. It will be recollected that throughout the whole of last summer and fall, and indeed up to the middle of January, the Kentucky river remained at an unusually low stage. The timber which had been cut off the banks along the pools of dams Nos. 2, 3 and 4, during the summer, consequently lay where it had been felled until the dams were nearly completed. Upon the first rise in the river, the whole floated off and lodged in immense compact masses immediately above the several dams. At Cedar, dam No. 3, the gorge extended about a mile in length, and was probably from ten to twenty feet in depth. In the early part of February, the river rose to a considerable height, and the floating masses passed over the dams with great violence." * * *

"The repairs have been completed in a manner which, it is believed, will render them permanent. Dams Nos. 2 and 3 are filled with stone in all parts; No. 4 is not filled above the angle of the breast under the lower slope. In place of the spike bolts used heretofore, long key bolts, of inch and quarter square iron, have been used to secure all the upper range timbers to which the covering plank is attached; those bolts pass down through the lower timbers of the dam, are secured by keys underneath, and are not liable to

become loosened and drawn out by the tremor of the dam or the action of the water."

"The advantages of flat lower slopes to dams were clearly exemplified in the action of the water at the several sites. At No. 3 the greater portion of the lower slope of the dam, in its incomplete condition, was wrenched off, so as to leave a vertical face in the line of the comb; whilst at Nos. 2 and 4, the general outline of the slope remained undisturbed. At the former the water fell over vertically upon the rock foundation; at the latter, the water, guided and upheld by the slope, expended much of its force in a horizontal direction against the back water below. At No. 3 the rock was torn up to such an extent as to form a bar across the river, immediately below the dam, which has yielded rock sufficient to fill up the whole of the dam below the comb; at No. 2, on the contrary, which is built upon a gravel foundation, sand, gravel, brush, &c. were deposited to a depth of several feet against the lower side of the dam, and the foundation remained secure, although the gravel bed of the river was cut away at some distance below the dam: at No. 4 also the rock bed of the river remains unchanged. Again, at No. 3, the water, even at its highest stage, had a fall of about two feet, and at medium stages reacted from a line about one hundred feet below the dam, forming a rapid surface current, *up stream*, across the whole width of the river. The drift, in passing over, disappeared beneath the surface, rose below, and was then brought back against the dam with such violence that the shocks might be heard distinctly for the distance of a mile. In this manner large trees were seen to be worn, and rounded off at the ends, by repeated impingements against the dam, until finally the accumulation of their numbers forced them away to make room for others. At no stage of water could a craft of any kind have passed in safety over the dam. At Nos. 2 and 4, on the contrary, where the general outline of the slope remained unbroken, there was no reaction at the surface at any stage of water, and the ordinary drift passed directly off without detriment to the dams. At the highest stage of water (15 feet on the dam) there was but a very few inches difference in the level of the surfaces above and below the dam, and the water glided off with a gentle undulatory motion. Steamboats have passed, in both directions, over dam No. 2, and could have passed over No. 4, at the highest stage of water, had an opportunity offered. The slope of No. 3 is now replaced, and it is believed that the drift will in future pass over that, as at the other dams, without doing further injury.

The steamboat New Argo, Captain Armstrong, was the first to pass through the locks, and arrived at Frankfort on the 14th of

February. The navigation continued open, for steam and flat boats, so long as the river continued navigable below lock No. 2, with some intermissions resulting from the incomplete condition of the lock-walls."

* * * * "The whole cost of the improvements is estimated at $848,960, including superintendence, lime, purchase of land at the various sites, and all contingencies. The amount of work done is $746,046.32. Amounts paid as follows, viz: to contractors, $563,711.01; manufacture of hydraulic lime, $53,978.76; transportation of hydraulic lime, $22,641.58; clearing the timber from the banks of the river, $18,525.50; purchase of land, $2,776.48; superintendence, engineering and surveys, $24,837.02; making a total amount paid, $686,470.35. The amount due for work done, including retained per centage, $59,575.97; value of work yet to be done, $102,913.68; and the amount required to complete the improvement, in addition to the amount already paid, is $162,489.35." * * *

"It may not be uninteresting to the geologist, to state that in nearly all of our excavations, detached teeth and bones of the mammoth have been found, in a state of excellent preservation, at depths generally of fifty feet below the surface of the ground, and at distances of one hundred to one hundred and fifty feet from the margin of the river."

Extract from the Report of N. B. Buford, *Resident Engineer of the Licking River Navigation, in Kentucky. Addressed to* S. Welch, Esq., *Chief Engineer. November*, 1840.

"The lime which was used, during the last year, on the Licking river, was obtained from the establishment at Louisville. The quantity derived from that place was 3,695 barrels in the year 1839, and 1,400 barrels in the present year, which have been distributed among all the locks."

"It having been previously ascertained that near locks Nos. 1, 2, 4 and 5, a material existed which was capable of being manufactured into hydraulic lime, in the month of June, by your directions I commenced erecting a horse mill and kiln at lock No. 2, according to plans furnished by yourself. On the 18th of August, the kiln and mill were put into operation; and, as soon as a little experience had been acquired in burning the lime and attending the mill, they were found capable of answering the purpose for which they were intended."

"The mill, kiln, and a house for the hands employed about the establishment, have cost $1,600; and we are capable of manufactur-

ing 60 bushels of lime per day, at a cost of 25 cents per bushel. We have already made 3,600 bushels of lime, at a cost of $900, and apprehend that it will not cost more in future. The mill at No. 2, by being kept employed all the year, will be capable of making all the lime required for locks Nos. 1 and 2. The transportation of the lime to No. 1 will cost about 8 cents per bushel. If the amount required at the two locks should be 20,000 bushels, and the mill should be useless at the close of the work, its cost would be an increase of 8 cents per bushel on the lime made. So the lime at No. 2 would cost 33 cents per bushel; and that at No. 1, by adding the transportation, would cost 41 cents."

"The lime made has been fully tested, and found to be of a good quality. It does not set so readily as that from Louisville, but in two or three weeks it is equally hard."

Second Report of the Directors of the New York and Erie Railroad Company, to the Stockholders. February 3rd, 1841.

[CONCLUDED FROM PAGE 328.]

NOTE D.—TOLLS ON COMMON ROADS INCREASED BY RAILROADS.

"The report of the minister of public works in Belgium, states a remarkable fact, and one at variance with the anticipations of most persons. It was supposed that this new mode of transport, introduced to the extent now practised in Belgium, would destroy the old, and that the use of horses and ordinary carriages would be superseded. Such is not the fact. On the contrary, while railroads have been, in succession, extending themselves over the whole of the soil of Belgium, the produce of the tolls on the ordinary roads, instead of diminishing, has progressively increased. In proof of this, the following statement of the produce of the tolls is given:—

1831,	- - -	2,390,882 *fr.*	1836,	- - - -	2,447,985 *fr.*
1832,	- - -	2,195,343	1837,	- - - -	2,584,791
1833,	- - -	2,360,464	1838,	- - - -	2,759,543
1834,	- - -	2,415,769	1839,	10 months,	2,749,301
1835,	- - -	2,385,430			

Mr. Nothomb makes a comparison of the advantages to the public, in time and money, between the old mode of traveling by diligences, and the rate of traveling under the new tariff, which went into operation in 1839.

The average result is a saving of *half the time,* and of 33 per cent. in the price.

The saving in price is thus subdivided: in diligences 15 per cent.; chars-a-bancs 30 per cent.; wagons 60 per cent. It is the lower class who profit most by the establishment of railroads. They not only find the means of transport, which were almost denied them before, but they find the means of labour increased. It is officially stated in

this report that the building of the railroads of Belgium has produced the result of increasing the produce of all the indirect taxes."

Increase of Passengers by the Establishment of Railways.

"From Baron Charles Dupin's Report on the Paris and Orleans railway. Experience has proved both in France and abroad, that in a short space of time the facility, expedition, and economy afforded by railways more than doubles the number of passengers and the quantity of merchandize.

In order to support such statements, we will quote the following facts relative to the railways of Belgium, England, and Scotland, in positions of extreme difference, and giving rise to a variation in the returns which far exceeded all anticipations."

"Comparison of the number of travelers conveyed daily throughout the whole, or a portion of the line:—

Railways.	*Before the establishment.*	*After the establishment,*
Manchester and Liverpool,	400	1,620
Stockton and Darlington,	130	630
Newcastle and Carlisle,	90	500
Arbroath and Forfar,	20	200
Brussels and Antwerp,	200	3,000

Increase of the number of passengers by the establishment of a Railway:

Liverpool and Manchester,	300 per cent.
Stockton and Darlington,	380 per cent.
Newcastle and Carlisle,	455 per cent.
Arbroath and Forfar,	900 per cent.
Brussels and Antwerp,	1,400 per cent.

Thus, even taking as a criterion the road on which the proportional increase is least of all, we still find that the number of passengers will increase not only 100 but 300 per cent. The transport of merchandize will experience a similarly rapid increase.

Progress in the conveyance of merchandize by Railway, compared to that of passengers:—

Year.	*Passengers.*	*Tons.*
1834,	924,063	22,909
1836,	1,248,552	161,501
1838,	1,535,189	274,808

Thus while the number of passengers has increased 60 per cent. in four years, in the same time the quantity of goods increased 1,100 per cent."

Extract from a late official report on English Railways, made to the French Government, by Edward Teisserence, its agent, charged with the special duty of making a study of these Railways:—

"The Darlington Railway has produced, by its low rate of passage and of freight, a complete revolution, in the region of country which

it traverses. It has increased the value of land 100 or 200 per cent. By these low rates, the freight, estimated at 80,000 tons, has been increased to 640,000 tons. The passengers, estimated at 4,000, have been increased to 200,000."

The following extract on the influence of Railways in developing the resources of a country, is taken from the second report of the Irish Railway Commissioners.

"On the Newcastle and Carlisle road, prior to the railway, the whole number of persons the public coaches were licensed to carry in a week was 343, or both ways 686; now the average daily number of passengers by Railway for the whole length, viz: 61 8-10 miles, is 228, or 1,596 in the week.

The number of passengers on the Dundee and Newtyle line, exceeds at this time 50,000 annually; the estimated number of persons who performed the same journey previous to the opening of the railway having been 4,000.

Previous to the opening of the railway between Liverpool and Manchester, there were about 400 passengers per day, or 146,000 per year, traveling between those places by coaches; whereas the present number by railway alone, exceeds 500,000.

In foreign countries the results arising from the same cause, are equally, if not more striking. The number of persons who usually passed by the road between Brussels and Antwerp, was 75,000 in the year; but since the railroad has been opened from the former place to Malines it has increased to 500,000; and since it was carried all through to Antwerp, the number has exceeded a million. The opening of a branch from Malines to Termonde, appears to have added 200,000 to the latter number; so that the passenger traffic of that railroad, superseding a road traffic of only 75,000 persons, now amounts to 1,200,000.

It is remarkable, that on this, as on most other railroads, the greatest number of passengers are those who travel short distances, being as two to one compared with those who go the whole distance. This appears from a statement read by Mr. Loch, before the Statistical Society of Manchester, showing that between April 30th and August 15th, 1836, 122,417 persons traveled the whole distance, and 244,834 short distances; chiefly to and from Malines."

(NOTE E.) *The following is a statement of the whole cost (including the amount raised by loans,) the lengths, cost per mile, etc., of a few of the principal railways of Great Britain. In every instance, the cost which is given, includes the whole capital outlay, for roadway, buildings, cars, locomotives, etc. etc. The pound sterling has been taken at $ 4 84.*

Liverpool and Manchester.

Cost up to the 30th of June, 1840, $6,810,717, of which $3,726,195 is in stock, and the remainder has been raised by loans.

The length of the road is $30\frac{66}{100}$ miles.

The cost per mile has been $ 222,137.

The whole capital of the company, on the 30th of June, 1840, including some items not properly chargeable to roadway and works, was $ 6,847,665. The earnings for the previous six months were at the rate of $8\frac{4}{10}$ per cent. on this capital, per annum. Wherever the dividends exceed 10 per cent. per annum, the tolls are by law to be reduced.

There are three tunnels at Liverpool, the aggregate length of which amounts to 4506 yards, and which have cost more than $ 1,500,000.

Stockton and Darlington.

Cost $ 1,210,000: viz. stock $ 736,000, and loans $ 484,000.

Length of the main line,	25.38	miles.
Four short branches,	12.75	"
Total,	38.13	"

The cost per mile, including the branches, has been $ 31,733. The dividends are £14 per each £100 share per annum, of which £10 per cent. is divided among the stockholders, and £4 per cent. is retained as a sinking fund. This road and its branches are used chiefly for the transportation of coal. Locomotive engines run on 24 miles; the remainder being worked by stationary engines and horse power.

Grand Junction.

The cost to the 30th of June, 1839, was $ 9,300,000.

Length (from Birmingham to Newton,) $82\frac{63}{100}$ miles.

Cost per mile, $ 112,550.

The whole amount of the company's stock at the present time, (all in shares or parts of shares,) including the cost of branches is $ 10,664,335.

The net profits, during the years 1838 and 1839, were $8\frac{6}{10}$ per cent. per annum.

London and Birmingham.

The cost to the 30th of June, 1840, was $ 27,580,135, viz: stock, $ 15,125,000, and loans, $ 12,455,135.

The length of the road is $112\frac{1}{4}$ miles.

The cost per mile has been, $ 245,702.

This road yields a profit of about 9 per cent. per annum, on the paid up capital. The gross income for the year ending 30th June, 1840, was $ 3,326,583, of which the receipts from passengers alone, were $ 2,446,518. The cost of land has been $ 30,000 per mile.

London and Southwestern, (or London and Southampton.)

Cost, $ 9,943,228, viz: in shares, $ 6,776,000; in loans, $ 3,167,228.

Length, $76\frac{7}{10}$ miles.

Cost per mile, $ 129,639.

Great Western.

This road is not yet completed. The amount expended up to the 30th of June, 1840, was $ 21,819,494.

The whole length of the road will be $117\frac{4}{10}$ miles, of which 75 miles are now in use, viz: 63 miles at the London end and 12 miles at the Bristol end.

It is estimated that this road will cost upwards of £50,000 per mile, say upwards of $ 242,000.

The average number of passengers per day, on the London end of the line, for the last two and a half years, has been upwards of 1500. Up to the 30th of June, 1840, the amount paid for lands and expenses relating thereto, was $ 3,475,449, being at the rate of more than $ 2,420 per acre, or $ 29,000 per mile.

Newcastle and Carlisle.

Probable cost, $ 4,598,000, that being the amount authorized by parliament to be raised. Of this there is in stock, about $ 2,613,600 the remainder having been raised by loans.

The length of the road is $61\frac{83}{100}$ miles.

The cost per mile has been $ 74,360.

Railway Property as an Investment.

"A correspondent calls our attention to the extraordinary increase in the value of railway property, which has taken place within the last six months. Comparing the quotations in our share list of the 14th of December last, with those of the 13th inst., it will be seen that upon twenty lines this increase amounts to upwards of *eight millions sterling!* Thus the Great Western shares in that period have risen 52*l.* per share, namely, from 10 discount to 42 premium, equal to 1,300,000*l.* upon 25,000 original shares; the new shares have risen from 5 discount to 20 premium, equal to 625,000*l.*—making altogether 1,925,000*l.* upon the old and new shares. The London and Birmingham shares have in like manner risen from 50 premium to 99 premium, equal to 1,225,000*l.* upon the 25,000 original shares; the quarter shares have risen from 22 to 30 premium, equal to 200,000*l.*; and the new shares have risen 13*l.*, equal to 405,950*l.*; making altogether upon the shares a sum of 1,830,950*l.* The shares of the other lines in the following table, are computed in the same manner:

Great Western, - - - -	£1,925,000
London and Birmingham, - - -	1,830,950
Grand Junction, - - - -	829,000
London and Southwestern, - - -	612,000
Eastern Counties, - - - -	488,000
North Midland, - - - -	420,000
London and Brighton, - - - -	360,000
Manchester and Leeds, - - - -	312,000
Midland Counties, - - - -	240,000

Manchester and Birmingham, - -	180,000
London and Croydon, - - - -	165,000
Great North of England, - - -	150,000
London and Blackwall, - - -	120,000
York and North Midland, - - -	120,000
Birmingham and Gloucester, - -	95,000
Chester and Crewe, - - - -	90,000
Bristol and Exeter, - - -	90,000
Cheltenham and Great Western, - -	75,000
Birmingham and Derby, - - -	63,000
London and Greenwich, - - -	60,000
	£ 8,224,959

These results cannot fail, as our correspondent remarks, to be most gratifying to Railway proprietors, as showing that public opinion has undergone a change; that railways are no longer viewed with suspicion as the mere speculation of a day, to be spoken of in the same breath with Spanish bonds, &c., but that they are regarded as real and valuable investments in the soil."—*Railway Times.*

Dangers of Railroad Traveling.

"It is ascertained by experiment, that the danger of loss of life on an average railroad trip is about 1 to 4,000,000. The following data on which this conclusion is founded, are copied from a late British publication:

Name of Railway.	*No. of Miles.*	*No. of Pas.*	*No. of Accidents.*	
London and Birmingham,	19,119,465	541,360	3 cases of contusions, no deaths,	(1)
Grand Junction,	97½*	214,064	2 cases of slight do,	(2)
Bolton and Leigh and Kenyon and Leigh,	3,923,012	508,763	2 deaths, 3 slight contusions,	(3)
Newcastle and Carlisle,	61*	8,540,759	5 death, four fractures,	(4)
Edinburgh and Dalkieth,	8*	1,557,612	one arm broken,	
Stockton and Darlington,	2,213,681	357,205	none.	
Great Western,	4,100,538	230,408	none.	
Liverpool and Manchester,	31*	3,521,820	8 deaths, no fractures,	(5)
Dublin and Kingston,	6*	26,410,152	5 deaths and contusions to pas'gers,	
London and Greenwich,	484,000	2,880,417	one passenger slightly bruised.	

* Length of road.

(1) None of these accidents occurred to actual passengers.

(2) None of these accidents occurred to actual passengers.

(3) None of the persons killed were passengers.

(4) One of the persons killed was a passenger.

(5) The whole of these were passengers; one of them a sergeant in charge of a deserter, who jumped off the carriage whilst in motion; the sergeant jumped after him to retake him, but was so much injured that he died; three others got out and walked on the road and were killed; the rest suffered by collisions of two trains, at different times. These include all the casualties from the very commencement of the working of the line."

(Note F.)

Statement of the cost, annual expenditures, receipts, etc., of several railways in the United States.

Name of Road.	Length in miles.	Total cost.	Expenses per annum.	R. ceipts per annum.	Profits per annum.	Per centage of profit.	Number of through passengers.	Number of way passengers.	Total number of passengers.
Utica and Syracuse, July, 1839, to July, 1840,	53	941,475	65,648	197 923	132,275	14	74,034	55 802	129,836
Utica and Schenectady, 1839,	78	1.855 052	119 630	400.671	281,041	15	95 776	86,823	182,599
Boston and Lowell, 1839,	26½	1,688,476	92 151	241,2 9	149,068	9	130.000		
Boston and Providence, 1839,	41	1.582,000	194,411	313.907	119,496	7	130,000		
Boston and Worcester, 1839,	44	1,848.085	126.384	231,807	105,423	6	90,000		
Camden and Amboy, 1839.	61	3,220,857	258,043	685,329	427 286	13¼			181,479
Philadelphia, Wilmington and Baltimore. 1839.	9 7	4,379,225	169 130	490,633	321,505	7½			213,650

Note.—The whole number of passengers on the Boston and Lowell, Boston and Providence, and Boston and Worcester roads, are reduced to through passengers.

In the cost of the Camden and Amboy road, the cost of steamboats and some other matters are included, and the expenses and earnings of the boats at the ends of the road are also included in the statement.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1840.

With Remarks and Exemplifications by the Editor.

1. For a mode of *Oiling and Protecting Mill Spindles from dirt;* Jesse Hubbard, Watertown, Connecticut, April 8.

A collar attached to the upper side of the bush, fits into a groove in the under side of the driver, so that neither meal nor any kind of dirt can reach the spindles; for this purpose the middle part of the driver is made larger than usual to admit of forming a groove of sufficient diameter to receive the collar on the bush, and of course of greater diameter than the spindle. An oil hole, or tube, passes down through the whole length of the damsel, the bail and the driver; so as to discharge the oil where the spindle bears against the bush.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the mode of protecting the spindle of the mill from meal and dirt, by means of the protection collar and groove, and of oiling the spindles by means of a hole through the damsel, bail and driver, as specified." In all of which there is but little novelty, the same end having been before attained by means very nearly resembling that which is the subject of the foregoing patent.

2. For improvements in the machine for *Making Bricks from Dry Clay;* Samuel Talbot, Richmond, Henrico county, Virginia, April 8.

Three, or more, moulds are made, in depth greater than the thick-

ness of the brick when pressed, and placed horizontally. The pistons for pressing are attached to a plate which is suspended by connecting rods to one end of a lever, and the plate is kept parallel with the surface of the moulds by means of two guide rods. The bottoms of the moulds, or "dischargers," are made similar to the pistons, and from the bottom of the plate, to which they are attached, descends a rod which answers as a guide to the motion of the plate, the lower end of which rod is connected to one end of a lever, passing under the machine. There is a table on each side of, and on a level with, the top of the moulds on which slides a discharger, which is simply a box without top or bottom, made to slide accurately by means of guides on each side, and this is connected by a rod to one end of a lever which vibrates horizontally, being actuated by cams on each side of a wheel acting on the other end of the lever which is forked for that purpose. The charger contains a sufficient quantity of dry clay for forming three bricks; when the charger is pushed over the moulds the clay drops into them, and it is then withdrawn. The pistons descend, press the brick, and the dischargers, or bottoms of the mould, then force up the bricks which carry up the pistons with them.

The lever which works the pistons, and that which works the dischargers are both operated by cams on the shaft of the cam wheel which works the charger.

The claim is to "the mode of producing the pressure on the pistons, by means of the lever operated by the cam, in combination with the mode of operating the dischargers; and also in combination with the foregoing, the mode of operating the box, or charger, and removing the bricks by the same."

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3. For an improvement in the manner of constructing *Stoves for Heating Apartments;* John Scott, Philadelphia, Pennsylvania, April 8.

This stove has an upright furnace, on the top of which is placed a drum, the upper part of the furnace passing through the cylindrical part of the drum and projecting some distance within it. The furnace is surrounded by a casing provided with holes for the admission of cold air which circulates around the furnace, becomes highly heated, and passes into the drum, through openings in which it is discharged into the room. A door is made in the cylindrical part of the drum for the supply of coal, which is thrown into a hopper. This hopper is connected with the furnace by a pipe, and a sliding valve is placed at the junction of the pipe and hopper, so that by closing the valve the coal can be thrown into the hopper without allowing the gas and dust to escape into the room; after the door has been closed the valve is opened and the coal falls into the furnace. A pipe passes through one end of the hopper and one end of the drum into the chimney flue. The object, as stated by the patentee, is to increase the radiating surface; to radiate the heat downwards so as to warm the feet of the persons sitting near, and to prevent the entrance of dust and dirt into the room. The patentee says, "I claim as my invention in the above

described stove, the manner in which I have combined and arranged the hopper, the drum and the furnace, as described."

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4. For a *Self Regulating and Oiling Mill Bush;* Samuel Moore, Borough of Chambersburg, Franklin county, Pennsylvania, April 8.

The exterior case of the bush is made of cast iron, is hollow, in form of a cross, and is let into the stone; through the centre of this case passes the mill spindle, the collar of which works between, and is sustained by, four brass boxes, one in each arm of the cross. These boxes are hollow and have two concave faces, so that when one is worn the other can be used by turning the box. The oil is supplied by means of a wick, or other fibrous material, which dips into the oil contained in the boxes, passes through a hole in the upper part of said boxes, and is brought into contact with the collar of the spindle, thus supplying the oil by capillary attraction. The boxes are borne up against the spindle by means of a spring acting on the back of each; and the tension of the spring is regulated by a nut working on a screw attached to the end of each arm of the cross, and passing loosely through a hole in the middle of the spring. The claim is to the manner in which the double faced brass boxes, or oil cups, are arranged and combined with the nuts, studs, and springs, so as to operate upon the spindle in the manner described.

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5. For an improvement in the manner of constructing the *Chairs for Railroads;* William Dripps, Coatsville, Chester county, Pennsylvania, April 8.

(See specification.)

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6. For an improved *Combined Mouldboard Plough;* Jonathan Knodle, Bakersville, Washington county, Maryland, April 8.

The disclaimer and claim accompanying the specification of this patent, will give a sufficiently clear idea of this improvement, viz: "I am aware that two or more ploughs have been combined together in the same frame, and I do not therefore make any claim to a combination as heretofore made. But what I do claim is the using of several mouldboards of cast-iron, of the ordinary construction of such mouldboards, but without land-sides; and the so arranging said mouldboards as that the point of either of those in the rear shall follow that which precedes it within the width of its furrow slice, in the manner and for the purpose herein set forth."

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7. For improvements in *Guns, Pistols, and other Fire Arms;* George Stocker and Joseph Bently, Birmingham, England, April 8, 1841.

There are three items claimed as improvements in this patent. The first is an explosion chamber within the breech, or solid "break-off," so that what flies off in the explosion of the cap shall not escape from said chamber. It is applied to guns in which the nipple is placed in

the back of the breech, the axis of the nipple being in a line with the axis of the barrel. This chamber is covered by a hinged plate which can be opened to place the cap on the nipple, &c. The second consists in a peculiar construction of the cock, which passes through the bottom plate and forms a handle in front of the trigger, and within the guard, the pins on which the cock works passing through two cheeks projecting from the trigger plate. To cock the gun, the lever of the cock is pushed towards the muzzle, and in a direction contrary to that of the motion of the trigger in discharging the gun. The third claim is to a mode of connecting the break-off, and the cock, and trigger plate, by means of a screw which passes through the break-off and screws into a piece of metal that projects from the inner side of the cock and trigger plate, thus embracing the stock. The trigger plate is provided with the usual screws in addition to that described.

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8. For improvements on *Harness for a Draft Horse;* Abel Post, Henrietta, Monroe county, New York, April 8.

These improvements are on that kind of harness in which the horse pulls by a strap passing around the breast, instead of by the collar around the neck, and consists simply, as the inventor states, "in forming a clasp, or hook, in the front of a *common breast collar* so that it can be separated there, to be taken off the horse; and also in substituting hames and pads in the place of the usual neck strap in the common English breast collar, so as to make the holding back easy for a horse." The claim is confined to the two devices above named.

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9. For improvements on the *Platform Balance;* Chauncey Crain and Evert L. Wemple, Madison, New York, April 8.

The rod which connects the platform lever with the steelyard beam is jointed, near its upper end, to a horizontal lever running under and jointed to the frame work of the steelyard. This lever is provided with a sliding weight regulated by a thumb screw passing through it and working in two pendants. By screwing the weight nearer to, or farther from, the connecting rod, the balance can be adjusted with the greatest accuracy. The same thing has been effected heretofore by having such a sliding weight attached to the steelyard beam.

Another improvement claimed is in substituting for the notches on the steelyard beam, a sliding clasp to which the weight is suspended. This clasp straddles the beam, and has two pointers, one on each side, to indicate the amount of weight.

The patentees say, "what we claim as our invention, and desire to secure by letters patent, is the method of balancing the levers by means of the weight suspended from the lever, between the pendants, and adjusted by the screw, as described. We claim also, the providing of the graduated lever with a clasp to which the movable weight is attached, with pointers to indicate, by the lines on the lever, the amount of weight on the platform."

10. For constructing and affixing the *Ribs of Cotton Gins;* Asa Copeland, Jr., Bridgewater, Plymouth county, Massachusetts, April 8. (See specification.)

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11. For improvements in machinery for operating the friction *Brakes of Railroad Cars;* John L. Clarke, Nashua, Hillsborough county, New Hampshire, April 11.

The brakes are of the usual construction, and are worked by a lever, one end of which is attached to the middle of the rod that runs across the car frame from one set of brakes to the other; the other end being attached to a double set of toggle joint levers suspended from the frame of the car. As the double toggle spreads, it relieves the brakes, and when it is straightened it forces them against the wheels. This working of the double toggle joint levers is effected by a sliding rod running through the whole length of the car and provided with two flanches or collars, one on each side, so that when the rod slides one way one of the flanches acts on one of the toggle joint levers and straightens it, and when it slides the other way the other flanch acts on the other toggle. The length of the rod in each car is so regulated that the bumpers can come together without bringing the ends of the rods into contact; but when the rod of the tender is forced back by the attendant, which is effected by a lever attached to the rod and passing through the floor, and the motion of the tender is arrested by the brakes, it comes in contact with the rod in the next car and forces it back, and so on from car to car until the whole train is affected. The forcing of the rod back carries the brakes up to the wheels and thus arrests the motion of the cars. The brake of the tender is worked in the usual way, and is so arranged as that it also can be worked by the arrangement before described. In this case the toggle used on the tender is single, and is embraced by a collar and slides freely on the rod, which is provided with a catch-dog hinged to it, and when the rod is forced back far enough the catch of the lever embraces the sliding collar and brings the toggle into play. The brakes can be acted upon either by a lever worked by the fireman or attendant, or by the momentum of the cars.

Claim.—"First, I claim arresting or retarding the progress of cars while in motion on a railway by a combination of rods connected with the friction brakes, by the intervention of toggles or progressive levers, transverse beam, or other suitable machinery, the whole arranged and operating by the momentum or power applied to the lever, substantially in the manner and on the principles herein described. Second, the method of connecting the rod of the tender and toggle by means of the combination of machinery, consisting of the dog, or catch, attached to the rod, piece of metal (sliding collar) shaped and arranged together, and acting in connexion with the levers, substantially as above described, for the purpose of operating the brakes by the momentum of the cars whenever the same may be necessary or desirable."

12. For a machine for *Cleansing and Washing Yarn and other Substances;* Sands Olcott, city of Philadelphia, Pennsylvania, April 11.

This machine consists of a series of fluted rollers, moving with equal velocity. The upper one of each set works within flanches on the under one, and receives motion from it by being pressed down in a manner similar to that of the draw rollers of a spinning machine. The yarn, or other substance, to be washed and cleansed is made into a skein or endless belt; a portion of it hangs in water, or other detergent, contained in a vat, whilst the rest is passing under the series of rollers; a roller is placed at the bottom of the vat, and around this the skein passes for the purpose of properly guiding it.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the construction of a machine for washing yarn and other substances by means of a series of pairs of fluted rollers, with flanches on one of each pair, in combination with the reservoir and trough, so that an endless skein can be passed continually through them, and at the same time be passing through the water or other liquid, for washing, as herein described."

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13. For a machine for *Reducing the Fibres of Flax and Hemp;* Sands Olcott, city of Philadelphia, Pennsylvania, April 11.

A cylinder provided with a series of circular saws, or teeth, like those of a cotton gin, revolves in a frame and has a revolving fan below it to clean the teeth of the saws. The fibres to be reduced are carried up to the saws by a series of cords which pass around a roller at each end of the frame and under a grooved roller above the saws. The last named roller has a groove for each saw and one for each cord. The claim is to "the combination of the gang of saws, or rows of teeth, on a cylinder, with the arrangement of cords and rollers for holding, guiding and working the flax and hemp, in the manner described."

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14. For a *Floating Swing Bridge;* John N. Vrooman, Danube, Herkimer county, New York, April 15.

One end of this bridge is attached, by means of a *pivot,* to a frame on the side of a canal, or other stream, whilst its other end is attached to a scow, boat, or buoy, and floats upon the water. When the bridge is floated into place for passage, it rises several inches above the frame built out from the bank. Why it is made to float so high is not stated, but we suppose that it is intended to provide against the inconvenience of low water, and to prevent the friction which would be consequent upon the dragging of such a weight on to the frame which receives it. It is stated that the bridge can be raised, in case of low water, by means of slides, screws, &c., by arrangements well known to mechanics, and which, therefore, need not be described. The swinging end of the bridge is connected with both shores, by means of ropes, so arranged that it can be opened from either; and it

is also provided with a latch to prevent it from swinging open except when desired. The ropes are so connected with the latch that it can be disengaged therefrom from the off shore.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the employment of a boat, scow, float, or buoy, for the purpose of sustaining the swinging end of the bridge in the manner described. I also claim the arrangement of ropes, or chains, by which the bridge can be opened or closed from either side of the canal or stream, as described, and in combination therewith the latch for retaining the bridge in its place when thrown back."

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15. For *Oiling Horizontal Shafts and Axles;* Hiram M. Smith, city of Richmond, Virginia, April 15.

Oil is to be supplied to the gudgeon, or gudgeons, of a shaft by means of a wheel which revolves in a reservoir of this fluid attached to the lower box of the gudgeon. The wheel has its bearings in a sliding frame, resting upon a spring which bears it up to the gudgeon of the shaft. The lower box being pierced to allow the wheel to come in contact with the gudgeon; this box is provided with a gutter on each side of the gudgeon to catch the oil, which runs back into the reservoir through a hole made for that purpose. A scraper, or wiper, is attached to the sliding frame of the wheel to wipe off, or remove, the surplus oil.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the wheel working in an oil cup, and a sliding frame, or gate, acted upon by a spring which adapts it to any irregularity of height the bearing is subject to, as herein described. I disclaim it as a friction roller, as I do not intend it to support the bearing, but merely to act as an oiler or feeder. I also claim the wiper and the gutters on each side of the bearing in combination with the wheel as herein described."

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16. For an improvement in *Swages or Dies for making Screw Augers;* William Field, Pawtucket, Providence county, Rhode Island, April 15.

There are two swages, or dies, which when put together form the matrix of a little more than the half of one twist of the augur. The metal is prepared by making it into a flat bar on the part to be twisted, with a round part above the twist. The swages are worked in any manner known to workmen, such as tilt or trip hammers, &c. That part of the swage or die which forms the thread in one half of said die, should extend some distance into the other half. As the dies are operated upon, the bar of metal should be turned round. It will be obvious that the flat bar will thus be twisted section by section until the whole twist be completed. The claim is to the forming the twist in screw augurs by means of the swages or dies constructed as described.

17. For an improvement in the *Cheese Press;* Rufus Porter, Billerica, Middlesex county, Massachusetts, April 15.

The design in this press is to produce the required pressure by the weight of the cheese which is being pressed. The board upon which the cheese is placed, and the one above it which gives the pressure, are attached to end pieces that slide upon each other and on the vertical sides or posts of the main frame. The side pieces of the boards slide upon each other to allow them to come close together, or to recede from each other. At each side two levers are arranged with their fulcra in the side pieces of the upper board, and act against the side pieces of the bottom board. These levers are bent upwards, and are united at their upper ends by the axis of a roller which bears against the outer edge of the posts of the frame that are swelled out, being much wider at the base than at the top. Thus it will be seen that when the cheese or other weight is placed on the bottom board it descends, and as it descends the rollers on the ends of the double levers are forced out by the swell on the outer edge of the posts, throwing out the upper ends of the levers, and thus compelling the two boards to approach each other. The claim is confined to "the mode of producing a pressure by means of the double levers, friction rollers, and swelled posts, as described." There have been two or three patents previously granted for causing the cheese to be pressed to operate by its own weight in producing the pressure, but under an arrangement of the respective parts different from that above described.

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18. For an improvement in the manner of constructing *Bee-Hives;* Martin Engel, of the borough of Easton, Pennsylvania, April 15.

The specification of this patent is of considerable length, and the drawings numerous; and as nothing short of a full description and representation would give any adequate idea of the construction of this hive, we must forego the attempt in the narrow limits of a notice.

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19. For improvements in *Tailors' Measuring Instruments;* William I. Lemmond, Lancasterville, South Carolina, April 18.

As we are not particularly acquainted with the art of measuring the human figure for the purpose of cutting garments, we will dismiss this article by quoting that part of the specification which expresses the nature of the invention, together with the claim, viz: "The nature of my invention consists in the combination of a horizontal graduated sliding strap, having graduated vertical sliding straps upon it, with tape measures attached to them with a graduated vertical strap. And also the combination of a graduated horizontal strap, having vertical sliding pieces with tape measures attached to them, with the vertical strap."

"What I claim as my invention, and which I desire to secure by letters patent, consists in the combination of the horizontal graduated sliding strap, having graduated vertical sliding straps upon it with

tape-measures attached to them, with the graduated vertical strap; and also the combination of the graduated horizontal strap, having vertical sliding pieces with tape measures attached to them, with the vertical strap."

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20. For a method of *Measuring the Body and Drafting Garments;* Isaiah J. Hendrix, Troy, Rensselaer county, New York, April 18.

The remarks made upon the preceding patent will apply to this. The patentee says—"The nature of my invention consists in the use of a flexible square applied to the body of the person to be measured, and also in the use of a protractor likewise applied to the body of the person to be measured, each and together furnishing, when properly applied, sufficient data to govern the mechanic in the correct cutting of a garment more easily and correctly to fit the varieties of form and persons, enabling the mechanic to take measures and note them down so that they can be applied to the cloth precisely as they are taken on the person, as the skilful surveyor delineates a map from the minutes which he has taken of the survey of an uneven surface." "What I claim as my invention and desire to secure by letters patent, is the mode of obtaining the backward or forward location of the shoulder strap and pitch of the shoulder seam by means of a flexible square and protractor, applied and used in the manner described."

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21. For improvements in the *Construction of Railroads;* James Herron, Baltimore, Maryland, April 18.

The first improvement is fully explained in the first section of the claim, which is in the following words, viz:—"What I claim as my invention, and desire to secure by letters patent, is, 1st. Placing the sills in the formation of a railway, so that they will cross each other in lines diagonal to the rails; and uniting them with each other and with the rails, so that they become struts and tie braces to the track, substantially, as described. And whereas said brace sills may be variously combined with each other, and with cross sills, and may be made to support an iron rail without the intervention of the timber string pieces; and may also, like common sills, be placed on a 'mud sill.' I distinctly claim to be the inventor of the *braced sill* or *latticed construction* of railway tracks under the modifications set forth, together with such variations thereof as may produce a like result by means substantially the same. I thus by the union in one, to an indefinite extent, of such materials as those that usually compose railway tracks, obtain by a united framing a more extensive and uniform bearing on the soil than the individual parts would have; all other railways having to depend upon the uniformity of soil, or artificial road-beds, for their evenness of surface. Whereas my railway track is independent in its formation of the soil on which it rests."

The second improvement consists in a mode of uniting or scarfing the string pieces, so that where the ends are put together they cannot

separate from each other except lengthwise, and the claim is to this peculiar mode of scarfing, which could not be understood without diagrams. The third improvement is for a mode of holding the iron rails by means of a spring, which presses the ends of two rails against the chair to prevent vibration, and at the same time permits them to slide lengthwise when expanding or contracting, which is effected by making the bolt which passes through the rail and chair with a double spring instead of a head, which thus holds the ends of the two rails; or by making a wrought iron chair, with ears on each side, that are bent over the web or seat of the rails, when laying them down. The claim is to the "method of evenly joining, and holding railway bars by means of a *metallic spring pressure*, so as to permit the contractile and expansive motion of the railway bar, whether said spring pressure operates by means of my malleable iron chairs, or as it may be variously modified and united with cast iron chairs, as described. The application of a spring to the rail for the purpose described being in itself new, and as said spring may be variously applied for producing the intended effect, it is to be understood that I claim the employment of a spring under the various modifications thereof described, and whenever it operates upon the principle and produces the effect in the manner set forth."

The fourth and last improvement is for a mode of holding the iron rails at the "middle of their lengths" by means of a piece of iron lying across the string, having two wrought iron ears which are bent over the web or base of the T rail, and being attached to the string by means of an iron strap screwed to the ends thereof, and passing under the string, or keyed under it. Or effecting the same thing by key bolts passing through the strings and the web or base of the T rail, by which mode "the iron rail is made to support the scarf of the string pieces or to form a part of the splice." The claim is to the mode of holding the rails at the middle of their lengths, as set forth.

We will only remark that the plan of construction proposed in this patent has been the subject of high commendation by some of our best practical engineers.

2?. For improved machinery for *Manufacturing stuffs in which the fibres of various materials are united with adhesive substances;* Thomas R. Williams, a citizen of the United States, now residing in England, April 24.

This invention consists of a new arrangement of machinery, by means of which all kinds of fibrous materials, such as cotton, silk, flax, hemp, tow, fur, wool, hair, &c. are combined, with adhesive compositions, into manufactured articles which may be applied to the purposes for which paper, pasteboard, millboard, papier maché, parchment, vellum, leather, woven fabrics, felt, floorcloth, tarpaulin and skins of animals are used.

A cylinder covered with wire gauze, &c. revolves in a case in which the fibres are suspended by a current of air, generated by a fan revolving in a case connected with the cylinder, which is so

arranged, by means of partitions, that the partial vacuum generated by the fan can only be supplied by the passage of air through the wire gauze covering of that half of the cylinder which, in its revolution, is above a horizontal line passing through the shaft. This current of air carries and deposites the fibres on the cylinder as it revolves, thus making a sheet, or batt, continuously, which is carried off between two pressing rollers. It is then carried between two rollers which apply the adhesive compound. The under roller revolves in a trough containing the melted compound, and carries up a sufficient quantity to apply to the under side of the batt, and the trough which applies the compound to the upper side is situated at the side of the upper roller so as to deliver the compound directly on to the batt. The rollers are kept hot by heaters, or in any other manner, and the upper one is weighted so as to press out the surplus of the composition and compress the batt.

The adhesive composition used in this part of the apparatus may be made of about three parts of pitch or rosin, with about one part of tar, to which add perhaps a thirtieth of oil or tallow, but the proportions necessarily vary for the different purposes for which it may be intended."

After the batt or sheet has passed through this apparatus, it may be cut and dried for use, or be carried through another composition consisting of weak size, mixed with paste and clay in different proportions, contained in a vat, and this is to be done by passing it over and under a series of rollers immersed in the compound, and then between two pressing rollers.

"The patentee says:—"I do not claim the forming of a batt or sheet from fibrous materials in the manner set forth, nor do I claim the machinery employed for the saturating of such a batt or sheet of fibrous materials with resinous and other substances; but what I do claim as of my invention and desire to secure by letters patent, is the so combining and arranging the machinery employed substantially in the manner herein set forth, as that the processes of forming the batt and of saturating the same with the different compounds shall be simultaneously and consecutively effected so as to form sheets or lengths of fibrous materials applicable to various purposes."

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23. For improvements in the machine for *Crushing Hard Substances;* James Rowe, Athens, Limestone county, Alabama, April 24.

This patent has been granted for alleged improvements on a machine long known, and used for crushing lime and other substances in preparing mortar, cement, &c., which machine consists of two wheels working on the ends of a beam attached to a vertical shaft, the wheels running in a circular trough surrounding the shaft.

The first improvement consists in a mode or modes by which the turning of the wheels is insured, either by making indentations on the peripheries of the wheels, into which fit knobs or projections made in the bottom of the trough, or by placing a cog-wheel on the shaft of each crushing wheel, which mashes into cogs made on the

outside of the trough. The second improvement is for applying weight to the wheels by balancing the beam in a mortise passing through the shaft, and having the shaft to rest upon the pin on which the beam is balanced, so that any weight applied to the upper gudgeon of the shaft by a weighted lever will of necessity be transferred to the wheels, and cause them to crush substances which could not be affected simply by the weight of the wheels. The claim is, first, to the "mode of preventing the grinding" (or crushing) "wheels from slipping by means of the cog gearing, or by cross projections and indentations of the valley, (trough), together with cuts, cogs, or notches on the tread of the wheels. And second, to the method of applying the weight of the centre revolving shaft, or any additional weight which may be applied thereto, to the grinding, or crushing, wheels by making the shaft bear upon the vibrating (balance) beam to which the wheels are attached, as described."

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24. For improvements in the *Power Loom,* so as to adapt it to the weaving of counterpanes; Erastus B. Bigelow, Lancaster, Worcester county, Massachusetts, April 24.

(See specification.)

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25. For *Constructing and Cording Bedsteads;* Martin Engel, of the Borough of Easton, Northampton county, Pennsylvania, April 24.

This bedstead is put together with round tenons, those on the end rails being longer than usual, and those on the side rails being provided with a pin projecting from the end of each, which passes into a hole made in those of the end rails. The end rails are round, and inside of the foot rail there is a roller having its gudgeons working in the side rails; and on the inside of the head rail there is another roller not provided with gudgeons but working freely within the side rails; to this roller a windlass is connected by means of straps which wind around it. The cord is in one piece, and one of its ends is attached to the roller inside of the head rail; from thence it passes over the head rail, then over the foot rail, around the roller within the foot rail, back over the foot rail, over the head rail, and around the roller within the head rail, and so on until the whole of the cord is taken up and the space within the rails corded. The cord is tightened by turning the windlass which winds up the straps, connecting it with the roller, next to the head rail, and draws it up, and thereby stretches the cord. The claim is to the above manner of connecting the rails, and to the mode of cording.

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26. For an improved mode of making *Metallic Heddles for Looms;* Charles Strong, Hartford, Windsor county, Vermont, April 24.

These heddles are made of narrow strips of tinned sheet iron, or other metal, having a hole made at each end to slip on to wires at the top and bottom of the frame. The eyelet hole is made by bending out the metal and then taking another piece of the same material

longer than the bent part, bent in a similar manner, and soldering the two together above and below the bent parts, thus leaving an opening sufficiently large to receive the thread. The selvage heddles are made in the same manner except that the eyelet holes are larger. For making highly sleyed cloths the heddles are arranged in two rows so as to bring the thread closer together, and for that purpose there are two wires at the top, and two at the bottom of the heddle frame, that the set of heddles on one wire shall come in a line with the space between the other set. The patentee disclaims the mere making of metallic heddles, and confines his claim to "the method of making the eyelet holes in the common and listing heddles, as described; and also to the method of arranging the metallic heddles in two rows instead of one, by which arrangement higher sleyed cloths may be woven by the metallic heddles than without that arrangement, as described."

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27. For improvements in the machinery for *Making Rivets;* Oliver Edes and Andrew Holmes, Braintree, Norfolk county, Massachusetts, April 24.

The claim refers throughout to the drawings and could not be understood without them, we will therefore merely attempt to give a general idea of the improvements claimed.

The first improvement consists in the construction of the cutting apparatus, the dies of which are semi-circular, so that in the operation of cutting the wire shall not be flattened, there being a standard, or gauge, against which the wire is forced by the operator to regulate the length of the rivet. The second is in the combination of the moving cutter, which separates the blank from the rod, with a spring arm for "pinching, or nipping, the piece of wire separated by the cutters, and conveying it downwards to the aperture" of the leading apparatus; and also in the arrangement of parts which withdraw the arm above mentioned from the blank after it has been carried to the heading apparatus. The third is in the combination of levers, &c., for forcing, or pushing, out the rivet from the aperture after the heading machinery has performed its office.

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28. For a *Movable Loading Muzzle for Rifles;* Alvan Clark, Cambridge, Middlesex county, Massachusetts, April 24.

The object of this improvement is to facilitate the loading of the rifle and to preserve the calibre of precisely the same diameter to the very point of delivery of the ball, and this is to be effected by means of what the inventor calls a "movable loading muzzle," which is put on to the end of the barrel for loading, and removed when the rifle is to be fired. The bore of this loading muzzle, where it meets the barrel, is of the same diameter with it, and is enlarged towards the mouth so as to receive the ball with ease, and gradually prepare it to be received by the barrel. The rifling of the barrel and muzzle should correspond. The muzzle may be fitted on by means of pins projecting

from it and fitting into holes made for that purpose in the end of the barrel. The claim is confined to this device.

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29. For improvements in the *Braiding Machine,* by which it is adapted to the braiding of Manilla or Sisal hemp; Elisha Fitzgerald, New York city, April 24.

This patent was granted for improvements on the ordinary braiding machine, in which the "bobbin carrier" travel a serpentine course around what is called a "pot." In this machine the double serpentine course only reaches around two thirds of the circumference of the pot, and after the bobbins have traveled to one end they return, and thus go from end to end interlacing the fibres or threads, and the improvements claimed consist, first, of two draw rollers, one of which has a continuous motion and the other pressing upon and receiving motion from it, which rollers receive and draw the braid, as it is made, from an eye-plate, so called because it has an eye through which the braid passes; this is placed above the machine, but in a line with the vertical axis of the pot. As the threads pass from the bobbins to the eye of the eye-plate, they, by being carried around and interlacing, form the braid; but to insure the proper formation of the selvages or edges of the braid, a circular guide plate is used on each side of the eye-plate, the centre of each of which is in a line with the eye and the centre of the circle around which the bobbins travel, in returning after they have reached the end of their circuit. The threads are carried around these guide plates and insure the proper formation of the selvages.

The claim is confined to the employment of the circular guide plates, and to the combination of the draw rollers with the spools, guide plates, and eye-plates, as described.

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30. For a *Corn Sheller;* Peter A. Gladwin, Chester, Middlesex county, Connecticut, April 24.

This corn sheller is an improvement on one patented to Lester E. Denison, and noticed in vol. xxvi of this Journal, page 160; it consists of what the patentee terms a "carrying cylinder," made of strips attached to two heads, the spaces between the strips are sufficiently large to receive an ear of corn of the largest size. A spring bottom is placed in each of these spaces for the purpose of pressing the ears of corn contained in them, against the concave, which consists of a series of shelling cylinders. As the carrying cylinder revolves, it brings each ear against the successive shelling cylinders. The shelling cylinders are made to revolve by a cog wheel on the shaft of the carrying cylinder which mashes into a pinion on the shaft of each of the shelling cylinders.

The claim is to "the forming of the concave with a number of shelling rollers arranged in the manner described, and also to the arrangement of the spring beds in the carrying cylinder instead of the concave."

In the machine patented to Lester E. Denison, a large shelling

cylinder revolves within the carrying cylinder, and the ears are forced against it by the spring concave.

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31. For an improvement in *Steam Boilers;* John Penniman, city of Baltimore, Maryland, April 24.

We will merely quote the claim appended to the specification as it gives a sufficiently clear idea of the improvement to bring it within the comprehension of any one, viz: "Having thus fully described the nature of my improvement, and the manner in which I carry the same into operation, what I claim therein as my invention, and desire to secure by letters patent, is the placing a series of circulating tubes on the front plate of the boiler, in such a manner as that they shall, at their lower ends, communicate with the water in the lower part of the boiler, and at their upper ends with the water in said boiler a little below the water line, whilst they are, along their whole length, exposed to the direct action of the heat in the fire box, in the manner and for the purpose above set forth."

In pointing out the effect produced by thus placing the tubes, the patentee says, "as these tubes open below into the lower part of the boiler, and at their upper ends into the upper part of it, below the water line, the water which will become highly heated in the lower parts of the tubes, will naturally ascend, and that with considerable rapidity, towards the upper part, where they will give out their steam, and by the action of the water circulating through them, they will necessarily draw the water in the lower part of the boiler towards them, and effect the required circulation."

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32. For a *Smut Machine;* Jacob Russel, Jenner Township, Somerset county, Pennsylvania, April 24.

Two revolving beaters, each consisting of eight perforated rings on a shaft, are placed in a case one above the other, their shafts laying horizontally. The case is made of perforated metal semi-cylindrical at top and bottom, and the two semi-cylindrical parts connected by vertical sides.

The patentee says, "I do not claim the mode of arranging the revolving beaters, the one set over the other, as herein set forth; but what I claim is the arranging them in a case formed with a double concave so that each series of fans, or beaters, shall revolve in a separate concave, as described."

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33. For improvements in the *Duplex Escapement for Watches;* Charles Edward Jacot des Combes, Baltimore, Maryland, April 30.

The patentee says, "my improvements consist of a new and improved mode of constructing the escapement, called by me the American Duplex Escapement, and also of an improved mode of rendering the movement of the seconds independent." We will not attempt a sketch of the construction of these improvements, as this could not be

done to any advantage without drawings; the claim refers throughout to the drawings, and could not be understood without them.

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34. For improvements in *Stoves for Heating Apartments;* William Frazier, city of Brooklyn, New York, April 30.

A cylindrical drum is placed alongside of the stove and communicating with it by two pipes one above and the other below the grate. The drum, or radiator, is divided into four parts by two partitions at right angles to each other, one of them extending from the top to near the bottom, and the other from the bottom to near the top; by this arrangement it will be seen that when the draft is carried through the drum, or radiator, it passes down one of the divisions under the partition, up and over the second, down the third, and under the partition to the fourth, from which it passes out through the pipe into another such radiator, or into the chimney. In each of the divisions is placed a pipe opening into the room at top and bottom for the air of the room to circulate through. The claim is to the combination of the partitions and pipes in the drum, or radiator. The number of drums, or radiators, can be increased at pleasure.

This stove resembles, and is designed as an improvement on, that patented by Denison Olmsted, of New Haven, Connecticut, on the 5th of November, 1834, a description of which will be found in vol. xv, of this Journal, page 407.

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35. For an apparatus for the *Treatment of Club Foot;* John B. Brown, M. D., Boston, Massachusetts, April 30.

The foot board of this apparatus is made in two parts, united by a joint so that the forward part, or that which receives the front part of the foot, can be turned to the right or left, by means of a screw in the heel part, the threads of which take into cogs on a sector attached to the forward part. "The remaining portions of the apparatus are similar to that heretofore used, with the exception of the upright standard," which is so constructed that it can be applied to legs of different lengths, by having the part of the standard to which the strap is attached made separate from the standard, and provided with a slot so as to attach it to the main part of the standard by screws, the slot allowing it to slide out or in, and thus to regulate the length. The patentee says that in some instances he connects the heels and toes of the two feet by means of yokes, which consist of two metal rods having their ends turned at right angles and fitting in a hole made in a metal ear attached to the heel and toe of the apparatus, so that by having one of these rods, or yokes, connecting the heels and another the toes of the two feet, the length of each being properly regulated, the "patient will be enabled to walk by taking short steps, until the muscles become accustomed to their new action, and the bones acquire their relative and natural position. When one foot only is deformed, a shoe is applied to the well foot with ears at the toe and heel for the insertion of the yokes."

The claim is confined to the mode of constructing the foot board in two parts, and to the manner of yoking the two feet together.

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36. For an improved mode of constructing the feeding part of *Straw Cutters;* Israel W. Groff, Lampeter Township, Lancaster county, Pennsylvania, April 30.

On the crank shaft which is placed across the machine under the straw box and about midway between the ends of the machine, there are two double cams at right angles to each other; one of them works a lever which is connected to, and operates, a dog, or hand, which is drawn up by a spiral spring, so as to make it catch on the underside of a ratchet wheel on the upper feed roller. A spiral spring keeps the lever against the cam. The hand or dog which works the ratchet wheel on the under feed roller is hinged to the first mentioned dog, or hand, so that the two feed rollers are operated together. The second cam actuates a lever which works the bearer by means of a rod which connects the two. The bearer is a block which rests upon the straw in front of the feed rollers, it is suspended to the ends of two arms projecting from a shaft, which has another arm at one end projecting from it at right angles to the two first mentioned, and to this last is jointed the rod which connects with the lever worked by the second cam. By this arrangement it will be seen that as the cam moves the lever the bearer will work up and down. The bearer and the upper feed roller have their bearings in an iron frame, the back end of which is jointed to the straw box. A spiral spring draws down this frame so as to press the upper feed roller and bearer on the straw. The cams are so regulated that before the feed rollers are turned the bearer is lifted up to allow the straw to be forced forward, and as soon as this has been effected the bearer is forced down again to press the straw preparatory to cutting. The claim is confined to the foregoing device for working the feed rollers, in combination with the bearer.

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37. For an apparatus for *Adjusting the Grinding Surfaces of Artificial Teeth;* James Cameron, city of Philadelphia, Pennsylvania, April 30.

The teeth when prepared are attached to two plates, the upper one for the teeth of the upper jaw, and the lower one for the teeth of the lower jaw. These plates are connected to a vertical rod on a standard, in a manner similar to that of the sliding reading lamp and its stand. The upper plate does not slide up and down, but can be drawn in and out, and set in an oblique position, and there retained by a set screw which passes through the vertical rod and acts on the round stem of the plate. The lower plate slides up and down on the rod and can be fixed at any point by a set screw. Like the upper one, it can receive any oblique position and is hinged so as to imitate the working of the under jaw. A rod attached to a slide may be placed at any point below it, to answer as a rest. By means of these plates

and adjustments the grinding surfaces of artificial teeth can be regulated and adjusted with the greatest nicety.

As the claim refers to the drawings, it would be useless to give it here, and we will therefore merely state that it is confined to the combination of the plates and standard rod, the rest for the lower plate and to the mode of regulating the motion of the lower plate.

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38. For improvements in the machine for *Picking and Opening Wool, Cotton, &c.;* George C. Kellogg and Phineas Gillett, New Hartford, Litchfield county, Connecticut, April 30.

The first improvement is in the mode of feeding the wool, or other fibrous substances, into the picking machine, and consists of a feeder roller with teeth all over its surface, which revolves nearly in contact with a concave, or shell, the lower edge of which receives the wool, cotton, &c., from the creeper cloth, where it is taken by the teeth of the feeder and carried up to the upper edge of the concave, or shell, where it is caught by the teeth of the picker. The upper edge of the shell extends up to a level with the axis of the feeder and whence it is turned down and forms a concave for the picker. The second improvement is in the mode of attaching the teeth to the lags of the picker cylinder by inserting them in holes made in the lags, and then securing them by means of screws, staples, or bolts, that pass through the lags at right angles to, and embrace, the teeth. By loosening the screw staples, or bolts, the teeth can be set or removed and replaced at pleasure.

The claim is to the combination of the feeder and shell, and to their combination with the picker cylinder; and also to the method of holding and setting the teeth in the lags by means of the screw staples or bolts, as described.

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39. For an improved *Process in the Art of Tanning Leather;* Richard T. Downing and George D. Smith, Philadelphia, Pennsylvania, April 30.

(See Specification.)

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40. For a *Seed Planter;* Lorenzo and Samuel H. Bachelder, Hampstead, Rockingham county, New Hampshire, April 30.

This patent is taken for an improvement in those parts of a seed planter which open the ground and conduct the seed from the dropping wheel to the furrow prepared for it. The dropping tube, or conducting pipe, is made in the back part of the coulter, and on each side of the coulter there is a wing, or share, and these two shares are united in front to a chisel-shaped projection, or nose. The under side of the double share is concave, and directly in front of the lower opening of the dropping tube there is a bar, or cross sill, running across the concavity for the purpose of smoothing the bottom of the furrow to receive the seed. The claim is to the combination of the coulter with

the share, nose, and bar, or cross sill, as described, and also to the combination of the dropping tube with the other parts named.

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41. For an improvement in *Fire Places to Prevent Smoking;* Horner Roberts, Delhi, Delaware county, New York, April 30.

The patentee says, "the nature of my invention consists of certain new and useful arrangements of curved and straight cast and wrought iron plates in and above the throat of the chimney by which the wind is prevented from blowing though the throat into the fire place and driving the smoke and fire into the room, and by which the draught is increased by the air becoming heated from said plates, and also said arrangement preventing an entrance of persons to the interior of the house through the chimney and fire place.

The form and arrangement of the plates could not be made intelligible without drawings. The claim is to the arrangement of the plates by which the effect specified is produced.

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42. For an improvement in the *Stump Extractor;* Frederick A. Stewart, Catherine, Chemung county, New York, April 30.

This patent was granted for an improvement on a stump extractor patented by Willard Foster, of Oswego, Tioga county, New York, on the 22nd of April, 1831, a notice of which will be found in the eighth volume of this Journal at page 167, and is merely for making the lever, to which the chain is attached, which passes around the stump, of two pieces, which are opened at the bottom to straddle the stump, they are joined together at the top, and are connected about midway by a cross piece; this is used in place of the single lever attached to a cross piece at the bottom, which rests on the ground by the side of the stump, as used by Foster. The objection alleged against Foster's is that from its peculiar construction when applied to a large stump, requiring the greatest amount of leverage, the foot of the lever has to be removed to a greater distance from the centre of the stump, thus decreasing the leverage, whereas when made as above, the lever can straddle the stump and its foot be placed as near the centre of the stump, as desired.

The claim is to "the construction of the lever as before described, so that the angle formed by the inclination of the lever and chain attached to the stump can be decreased at pleasure, independent of the size of the stump."

The patentee of the above is the owner of the patent granted to Willard Foster, and there are not, therefore, any interfering claims.

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43. For improvements in machinery for *Preparing and Spinning Flax and Hemp;* Moses Day, Roxbury, Suffolk county, Massachusetts, April 30.

The fibres of flax, or hemp, are prepared by means of teeth on three cylinders. The teeth are arranged in rows, each row attached

to a slide working within the cylinder, and passing through slots in the peripheries of said cylinders. The sets of teeth are projected beyond the surfaces of the cylinders during a portion of their circuit, and are drawn in during the remainder of their circuit, this is effected by having the ends of the slides, to which the teeth are attached, working in cam, or eccentric, grooves, made in plates at each end of the cylinders—the plates remaining permanent while the cylinders revolve. The fibres pass over the first cylinder, under the second, and over the third, where they are brought together to form the roving, or roping, and pass through a tube, or regulator, from whence the roving passes to the flyer to be spun. The tube, or, regulator, is connected by means of levers, and their appendages, to a latch which throws the cylinders in and out of gear, so that when the cylinders, or the preparative part of the machinery, supplies too much material, the roving becomes too large and moves the regulator which throws the preparative part of the machinery out of gear.

An improvement is claimed in the spinning part of this machine for the purpose of giving a back and forth motion to the spindle (the spindle being horizontal) to wind the yarn on the bobbin; this device consists of a single threaded screw on the spindle, which for this purpose passes out a considerable distance beyond the back of the flyer; there is also an arrangement of pullies and bands which could not be clearly understood without drawings, the claim to this part refers throughout to the drawings.

The claim is to "the combination of the revolving drums and several rows of teeth with the machinery within said drums for operating the several series of teeth, or metallic points, as described. The regulator as described, and the combination of the regulator with the several different series of teeth, formed as described, (those near the sides of the drums being shorter than those near the centre of the same,) which arrangement, in conjunction with the peculiar shape of the regulator, forms the roving. Also stopping the preparative part of the machinery by means of the regulator in combination" with the arrangement of levers, clutch, &c. And finally to the arrangement made for imparting a reciprocating rectilinear motion to the spindle.

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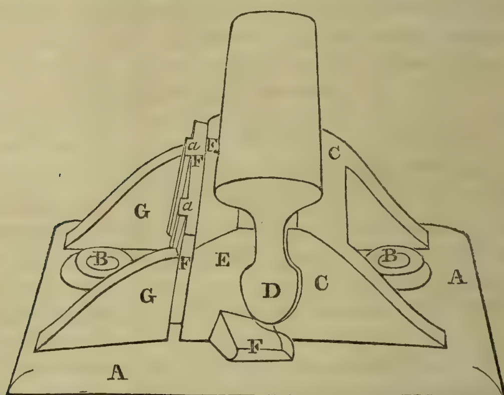
44. For a method of *Stiffening Rocket Staffs;* John W. Cochran, New York, April 30.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the method of stiffening rocket staffs by means of metallic stiffeners in the form of cylindrical metallic tubes, or with a cylindrical metallic tube having flanches, or with the metallic flanches, as above described." It is only necessary to say that wood is put upon the outside of the metallic part, indicated in the above claim, to complete the rocket staff.

Specifications of American Patents.

Specification of a Patent for an Improvement in the manner of constructing the Chairs for Railroads. Granted to William Dripps, *Coatsville, Chester county, Pennsylvania, April 8th,* 1840.

To all whom it may concern: Be it known that I William Dripps, of Coatsville, in the county of Chester, and state of Pennsylvania, have invented an improvement in the manner of constructing the chairs for sustaining and holding the edge rails for railroads; and I do hereby declare that the following is a full and exact description thereof:



The accompanying drawing gives a perspective view of my railroad chair, embracing a portion of a rail. A A, is the sole or basement of my chair, which may be bolted down by bolts passing through the holes B B, or fastened in any other way which may be preferred. C C, is a cheek cast solid with the sole A A, and so formed as to receive one half of the lower part of the rail D; the other half is embraced by the separate casting E E, which has a jog F, cast on each of its ends, which jogs embrace the lower part of the cheek C C, and prevent E E from moving laterally. When E E is dropped into its place, and made to embrace the rail, it is confined there by means of the wedge plate F F, one side of which bears against it, whilst the other side is supported by the cheek C C, cast solid with the sole A A. The wedge plate F F, has ledges *a a*, upon its back, to guide and keep it in place, and it may have a cross ledge to receive the end of a crow-bar when it is required to be raised. It will be seen that by this manner of constructing railroad chairs, the respective pieces by which the rail is held in place cannot possibly became loosened by the vibration of the rail, or from any other cause, as the wedge plate, which confines the whole, will always tighten itself by its own gravity, and will consequently keep the whole firmly in place.

Having thus fully described the manner in which I construct my railroad chair, and shown how the same operates in producing the

intended effect, what I claim therein as of my invention, and desire to secure by letters patent, is the particular combination of the respective parts thereof, constructed, formed, and operating substantially as set forth, that is to say, I claim the combination of the cheek piece C C, with the separate cheek piece or casting, E E, and the plate wedge F F, producing their combined effect in the manner described.

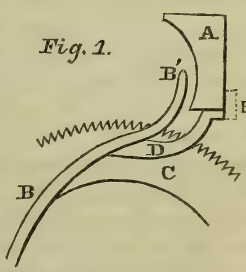
WILLIAM DRIPPS.

Specification of a Patent for constructing and affixing the Ribs of Cotton Gins. Granted to ASA COPELAND, JR., *Bridgewater, Massachusetts, April 8th,* 1840.

To all whom it may concern: Be it known that I Asa Copeland, Jr., of Bridgewater, in the county of Plymouth, and state of Massachusetts, have made certain improvements in the manner of constructing and affixing the ribs or grates of saw gins for ginning cotton, and I do hereby declare that the following is a full and exact description thereof:

In the saw gin as ordinarily constructed, the cotton is liable to collect in the spaces between the ribs and around them, above the point where the saws operate, thus choking or clogging the grate and preventing the rising and free escape of the fibres and seed therefrom. To obviate this inconvenience, instead of attaching the ribs by their upper ends directly to the part usually denominated the breast or grate fall, I in general extend a brace or arm out from near the upper ends of said ribs, by which to attach them to the breast in such a manner as that they shall stand out from said breast, and leave a free space of the fourth of an inch, more or less, for the escape of the cotton. The attachment may be made to the front, bottom, or back of the breast, and the mode in which this is effected will admit of much variation without departing from the general principle on which the improvement is founded.

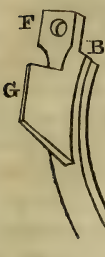
Fig. 1.



In the accompanying drawing, fig. 1 represents a section of the breast A, with a rib B, attached to it, C being one of the saws. D is a brace or arm extending out from the under side of the rib, and attached by a screw to the under side of the breast at E. I sometimes carry the end E up on the back side of the breast, and screw it to that part, as shown by the dotted lines, or it may be carried up on the front and there attached. The arm D may be round or flat where it leaves the rib B, and it should be made narrower than the rib, say about two-thirds of its width. The top end B stands at a distance of one-fourth of an inch, or nearly so, from the lower part of the breast, the distance increasing towards the extreme end, so as to remove all obstruction out of the way of the ascent of the fibres of cotton.

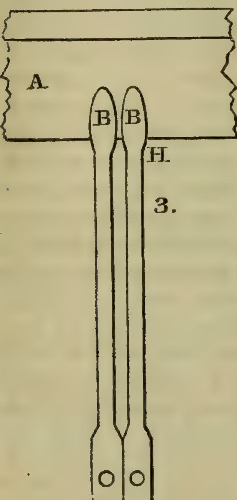
In the above described arrangement, the teeth of the saw pass be-

tween the ribs at a point above the branching off of the arm D, as shown in fig. 1, but I sometimes omit this arm and attach the rib in another manner to the front of the breast, in which case it may be constructed as shown in fig. 2, in which F is a piece extending above the point or upper end of the rib, through which it is screwed to the front of the breast, it being so formed as to sustain the end, B, of the rib at a distance from the breast, similar to the part B′ in fig. 1. G is a wing or flat piece projecting out from the rib, and which is let into the breast; the whole of the said rib is above the saw, and the fibres pass freely up on either side of it and escape with the seed at the top. Although this mode of construction has been found to answer a good purpose, that first described is preferred.



2.

Fig. 3 shows the form which I give to the faces or outsides of the ribs, A being a portion of the breast or grate fall, with two of the ribs attached thereto; at the part H where the saw terminates, I widen them out as shown in the drawing, so as to narrow the space between them, and then again narrow them off towards the point, to aid in affording an unobstructed rise and escape of the fibres and seed.



3.

What I claim as my invention and improvement in constructing and affixing the ribs of saw gins for the ginning of cotton, is the so forming and affixing them to the breast or grate fall as that their upper ends shall stand off from the front of said breast in the manner herein described, in order to allow of a free and uninterrupted rise and escape of the fibres and seed from the upper ends of said ribs, and this I claim, whether the said ribs be formed and attached precisely in the manner set forth or in any other way which is substantially the same, and by which a like result is obtained.

Asa Copeland, Jr.

Specification of an Improved Power Loom, by which it is adapted to the weaving of Counterpanes. Granted to Erastus B. Bigelow, *Lancaster, Worcester county, Massachusetts, April 24th,* 1840.

To all whom it may concern: Be it known that I, Erastus B. Bigelow, of Lancaster, in the county of Worcester, and state of Massachusetts, have invented a new and improved mode of constructing the power loom, by which improvement it is adapted to the weaving of figured counterpanes and to other articles of a similar character; and I do hereby declare that the following is a full and exact description thereof.

My improvements consist principally in the manner in which the shuttles are thrown; the manner of raising and depressing the shuttle boxes, and the manner in which the picker is relieved from the shuttle.

In throwing the shuttles I cause the two picker staves to operate simultaneously, so that the shuttle may be thrown from whichever of the boxes is presented to their action. This is effected by the use of one picker treadle only, which is acted upon by a cam ball, in the usual way of working such treadles. From this treadle two bands are extended, and pass around the two picker pulleys, in such manner that when the treadle is depressed, both the picker staves will be set in action at the same moment. By this arrangement two or more shuttles may be successively thrown from the same end of the loom by the action of one treadle.

The shuttle boxes are raised and lowered in the following manner. A shaft extends along under the race beam, from one shuttle box to the other, and carries pinions which take into racks attached to the shuttle boxes; it will be manifest, therefore, that by causing this shaft to revolve, the shuttle boxes may be raised. The revolving of this shaft is effected by the action of a spiral, or other, spring, one end of which is attached to the frame of the loom at its back, and said spring extends forwards towards the lathe; from this forward end a band, attached to it, passes around guide pulleys, and also around a pulley upon the above named shaft, to which latter the said band is attached. The action of the spring, by its drawing upon the band, will cause the pinion shaft to revolve, and will consequently raise the shuttle boxes. Should this spring be thrown out of action, and the band by which the shuttle boxes are raised be relaxed, they will then descend by their own gravity. To take off the tension of the spring there is a cam upon the main shaft of the loom, which cam, as the shaft revolves, depresses a treadle, to the end of which a band is attached which operates in such a way as to relieve the shuttle boxes from the action of the spring, and they then descend.

In relieving the picker from the point of the shuttle, I make use of the protection rod constituting a part of the apparatus employed in the ordinary power loom for stopping the loom when the shuttle does not arrive home in the shuttle box. From the protection rod, which extends along below the shuttle boxes, I allow a small arm, or finger, to descend, which finger, as the lathe comes up towards the breast beam, strikes against a stop, or pin, attached for that purpose to the frame of the loom, causing the protection rod to rock or revolve to a short distance. This gives motion to two arms which extend out from the extreme ends of the protection rod, opposite to the outer ends of each of the shuttle boxes; from these arms motion is communicated to a lever which works on a fulcrum over the outer ends of each of the shuttle boxes, said arms being connected to the levers by rods, or wires. By depressing the outer ends of these levers their inner ends are raised, and to these ends are appended rods which carry pieces of wood or metal which when down rest on and embrace the picker rod, and in that position they serve to hold the picker at a short distance from the end of the shuttle box, and to stop the shuttle; the picker is then

removed from the point of the shuttle by the raising of the lever, the picker being made to pass home to the end of the box, thus leaving the shuttle and shuttle box free to be raised or lowered without obstruction, the picker being also ready again to act on a shuttle. The picker is removed from the point of the shuttle, after the block has been raised by a rod, actuated by a spring, which rod is connected with the picker stave by a cord, in order that the stave may, by its motion, move the rod, also that it may not impede the motion of the picker.

Having thus fully described the nature of my improvements, and shown the manner in which I carry the same into operation, what I claim as constituting my invention, and desire to secure by letters patent, is, first, the manner in which the picker staves are operated upon by a single treadle so as to act simultaneously, whereby two or more shuttles may be thrown successively from the same shuttle box, if required; the apparatus therefor being constructed substantially as set forth. Secondly, I claim the raising the shuttle boxes by the action of a spring, or springs, weight, or weights, and the allowing them to descend by their own gravity when the tension of the spring, or the force of the weights, is taken off; the same being effected in the manner described, or in any other analogous thereto. Thirdly, I claim the relieving of the shuttle from the picker, by means of an apparatus constructed and operating as herein described, that is to say, by the combined action of the levers, the pieces of wood or metal, and the rods, connected by cords to the picker stave, connected and operating substantially as described.* ERASTUS B. BIGELOW.

Specification of a Patent for an improvement in the art of Tanning. Granted to RICHARD T. DOWNING *and* GEORGE D. SMITH, *of the city of Philadelphia, April 30th,* 1840.

To all to whom these presents shall come: Be it known that we, Richard T. Downing and George D. Smith, of the city of Philadelphia and state of Pennsylvania, have invented a new and useful improvement in the art of tanning, and that the following is a full and exact description of our said invention and of the manner and process of making, constructing and using the same.

In the process of tanning leather by suspending hides in liquor, on what is termed Brown's Patent Reels, or any other mode of suspending or immersing the hides in liquor, it has been found impossible to produce thereby a durable color, or bloom, as is produced by handling leather up and down in liquor, at first, and subsequently by laying away in liquor with a stratum of bark between each hide or half hide. In consequence of this apparent deficiency in the system of tanning by suspending hides in liquor until they are tanned, the most approved tanners of that class have had to resort to the expedient of laying away their leather in vats suitable for the purpose with strata of bark between, as before described, thus incurring additional expense and loss of time.

* In the original there are drawings, with references thereto.

Now it has been discovered, by the applicants, that immediately upon the suspension of the hides in the liquor, a sediment commences to collect upon the grain, or surface, of the hide, and to adhere to it so firmly as to prevent the natural action of the bleaching, or blooming, properties of most bark and other liquors containing the tannin principle, upon the removal of which obstruction the liquor acts upon the hide so as to form the most perfect and uniform color and bloom, similar, or superior, to that which is obtained by means of laying away with bark as aforesaid.

The removal of this sediment also facilitates the operation of tanning, and increases the pliableness of the leather. For this purpose we have constructed a cleansing brush made by the insertion of stiff bristles, say from three to four inches long, (depending on the space between the hides) on each side of a board from one to one and a half inch thick, six to ten inches wide and eighteen to twenty-four inches long, made in the form of a paddle, with a handle about seven feet long. This brush is furnished with bristles all around it. When used, this brush is placed between two sides suspended as aforesaid, and placed grain to grain, and worked up and down by hand, by which the sediment is prevented from collecting on the surface of the leather.

What we claim as our invention or discovery is an improvement in the art or process of tanning by cleansing the hides whilst suspended in bark or other liquor containing the tannin principle, by means of a brush with a long handle, made and used as above set forth, in order to prevent the collection of any sediment, dirt or impurity upon the surface, or grain, of the leather, and thus to allow the liquor to act, to produce gradually the commencement of the process, the desirable color, or bloom, and giving the tannin a free access through the pores to unite with the gelatine of the hide.

Richard T. Downing,
George D. Smith.

Proceedings in an Appeal from the decision of the Commissioner of Patents, Henry L. Ellsworth, Esq., *rejecting the application of* John F. Kemper, Esq., *of Cincinnati, Ohio, for a Patent for an Improvement in the Manner of Stowing Ice.*

[CONCLUDED FROM PAGE 359.]

Opinion of the Chief Justice.

The petition of John F. Kemper sets forth that he "has *invented* certain *improvements* in the manner of constructing vessels for the stowing and carrying ice; and also *an improvement in the manner of stowing the same;* and prays that letters patent of the United States may be granted to him *therefor,* securing to him and his legal representatives an exclusive right in and to his said invention agreeably to the provisions of the acts of Congress in that case made and provided; he having paid thirty dollars into the Treasury of the United States, and otherwise complied with the requirements of the said acts."

In his specification, after describing his vessel and the improvements in the same, and certain matters to be attended to in the stowing of the ice, he says:

"I have discovered that for the purpose of keeping ice for a great length of time it is necessary in stowing it, to place all the pieces edgewise, as, when placed flatwise, small openings are formed through it by the percolation of water or otherwise, and that this injurious effect goes on increasing, and eventually producing a rapid destruction thereof; this I obviate by carefully packing all the blocks edgewise, when, as experience has abundantly shown, no such effect is produced. This mode of stowage applies not only to vessels, but also to ice houses, and whenever ice is to be preserved."

After stating what he disclaims, and what he claims as his invention and improvements in constructing vessels for the transportation of ice, he says:

"In the manner of stowing the ice I claim the placing of the prepared blocks edgewise, in the manner and for the beneficial purpose herein set forth."

No objection was made by the Commissioner of Patents to the grant of a patent for the novel construction of vessels for the transportation of ice, as claimed by him; but the Commissioner decided that the applicant was not entitled to receive a patent for the manner of stowing the ice by placing the blocks edgewise.

From this decision he has appealed according to the provisions of the 11th section of the act of March 3d, 1839, and the 7th section of the act of July 4th, 1836; and has filed in the patent office his reasons of appeal, and paid the sum of twenty-five dollars to the credit of the patent fund.

By the 11th section of the act of March 3d, 1839, ch. 88, (pamphlet edition) the Judge is to confine his revision to the points involved in the *reasons of appeal;* and the Commissioner of patents is to lay before the Judge, the grounds of his decision touching the same point.

The applicant claims a patent for his vessel, and his manner of stowing ice in vessels and ice houses, as one invention, and pays thirty dollars as for one patent.

The Commissioner denies his right to a patent for his manner of stowing, but admits it for his improvement in the construction of his vessel.

The first and principal point involved in the reasons of appeal, is whether the thing for which the patent is claimed is the invention or discovery of a new and useful art, or of a new improvement on an art, within the meaning of the Constitution and laws of the United States respecting patents.

The invention, if it be one, consists only in laying each block of ice on its narrowest side. Can that act be considered as a new thing invented or made? Was it never done before? If it has been done before, although the *beneficial effect* of so placing it, rather than on its broadest side, had not been discovered, it is not a new thing. The only thing new is the discovery of the beneficial effect—and that is the discovery of a thing which existed before, for if it is now true that ice so placed keeps longer than when differently placed, it was always true—and that it existed before is shown in the specification where it is said that the effect was discovered by *experience.*

Much of the confusion of ideas upon this subject has arisen from the ambiguity of the words "*discover*" and "*discovery*" used in the Constitution and the patent laws of the United States. In their primary and common sense they are not synonimous with "*invent*" and "*invention.*"

Webster, in the last 8vo. edition of his dictionary, under the word "*discover*," says, "*discover* differs from *invent*. We *discover* what *before existed.* We *invent* what did *not before exist.*" And under the article "*invention*" he says, "*invention* differs from *discovery*, invention is applied to the contrivance and production of something that did not before exist. *Discovery* brings to light that which *existed before*, but which was not known."

A discovery, in this sense, is not the subject of a patent; and it will be found, by a careful perusal of the Constitution and Laws of the United States upon the subject of patents for useful arts, &c., that it is not there used in this sense but always as synonimous with *invention.*

Thus the Constitution (in ch. 4, art. 1, sec. 8, clause 8,) among the enumerated powers given to Congress, says—"To promote the progress of science and useful arts, by securing, for limited times, to authors and *inventors* the exclusive right to their respective writings and *discoveries*."

Here it is evident that the "*discoveries*," the use of which is to be secured, are the discoveries of *inventors* only. The applicant must invent, contrive, or produce something that did not exist before. A man may *discover* (i. e. may disclose) his *invention;* and for that discovery or disclosure he will be entitled to the exclusive use of his *invention* for a limited time.

In the first act of Congress "to promote the progress of useful arts," passed April 10, 1790, the words *invention* and *discovery* are used synonimously throughout the whole act; and whether application was for a patent, for an invention, or a discovery, it must be founded upon an invention or discovery of an useful art, &c., (or improvement therein,) not before known or used. The discovery of a new art, that will justify a patent under that act can be only the *invention* of a new art, and the discovery of a new improvement the *invention* of a new improvement. In every case, therefore, the applicant must be the inventor; and by the Constitution none but *inventors* could be entitled to the monopoly.

The next act was passed on the 21st of February, 1793, entitled "an act to promote the progress of useful arts; and to repeal the act heretofore made for that purpose."

By the first section of this act, the applicant was to declare that he had *invented*, not discovered, a new and useful art, &c., or improvement, &c., and the patent was to give a short description of the said invention or *discovery*. Here "*discovery*" is intended to be synonimous with invention, for the claimant had alleged an *invention only;* and it is afterwards again, in the same section, called, the said invention or *discovery*. The second section says that any person who shall have *discovered* an improvement and obtained a patent therefor shall

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not be at liberty to use "the original *discovery*, nor shall the first *inventor* (i. e. of the *original discovery*, which he had alleged to be his *invention*,) be at liberty to use the improvement." And a change of form or proportions, was not to be "deemed a *discovery*." By the third section every *inventor* was to swear or affirm that he believed that he was "the true inventor or *discoverer* of the art," &c., and deliver a written description of his *invention*, by which it may be distinguished from other *inventions*.

The fourth and fifth sections speak of *inventors* and *inventions* without saying any thing of discoverers, or discoveries.

The sixth section, alluding to the same *invention*, calls it "his *discovery*," and speaks of *original discovery*, and *supposed discovery*, and the *discovery of another man*, and all these expressions are used in reference to what had been patented as *inventions*. The tenth section speaks of the *true inventor or discoverer*, and the eleventh section provides that every *inventor* shall pay thirty dollars before he presents his petition.

The act of the 17th of April, 1800, only extends the privileges of the former act to aliens and to the legal representatives of *inventors* and *discoverers*, &c., and gives treble damages for violation of patent rights.

The act of July 13th, 1832, applies only to aliens.

The next act is that of July 4th, 1836, entitled "an act to promote the progress of useful arts, and to repeal all acts and parts of acts heretofore made for that purpose."

The first section speaks of "issuing patents for new and useful *discoveries, inventions and improvements*," as part of the business of the Commissioner of Patents whose office was therein created.

In the fifth section the words *invention* and *discovery* as used throughout are synonimous.

The sixth section, which declares for what a patent may issue, shows that the applicant must have "*discovered* or *invented* some *new* art, &c., or improvement, and it is called "his discovery or invention thereof," and he is called the *inventor* or *discoverer*. It then says, "but before any *inventor* shall receive a patent for any such new *invention* or *discovery*, he shall deliver a written description of his *invention* or *discovery*. The descriptions and drawings are to be signed by the *inventor*, and he is to furnish a model of his *invention*, and he is to make oath that he does verily believe that he is the original and first *inventor* or *discoverer* of the art, &c., or improvement, for which he solicits a patent; and that he does not know or believe that *the same* was ever before known or used."

In the seventh section wherever the word *discovery* or *discoverer* is coupled with invention or inventor, it is evident that it means the discovery or discoverer of something *new*, something that did not exist before, and therefore equivalent to *invention* and *inventor*. In the latter part of the section it speaks of the science to which the alleged *invention* appertains, and of the part, or parts, of the *invention* which he, the Commissioner, considers as not entitled to be patented.

The eighth section speaks of the right of an *original and true in-*

ventor to a patent for his *invention*, and says nothing of a *discovery* or *discoverer.*

The twelfth section speaks only of *invention* not discovery, yet it is evidently applicable to the former sections which use the words *invention* or *discovery.*

The thirteenth section provides that where a patent shall be "invalid by reason of the patentee claiming in his specification, as his own *invention*, more than he had a right to claim *as new*, the Commissioner may cause a new patent to be issued to the said *inventor* for the same *invention*, &c. The same section afterwards speaks of a " description and specification of any new improvement of the original *invention* or *discovery* which shall have been *invented* or *discovered by him*, the patentee, subsequent to the date of his patent."

The fifteenth section specifies the special matter which may be given in evidence by the Defendent under the general issue, among which is evidence tending to prove that the description and specification filed by the Plaintiff does not contain the whole truth relative to his *invention* or *discovery*, or that the patentee was not the original and first *inventor* or *discoverer* of the *thing* patented, or of a substantial and material part thereof claimed *as new;* or that he had surreptitiously, or unjustly, obtained the patent for that which was, in fact, *invented* or *discovered* by another. It also speaks of "the *invention* or *discovery* for which the patent issued." It speaks also of the first *inventor* without adding *discoverer;* and of the *invention* without adding *discovery.*

The sixteenth section speaks of the *invention* patented, and generally of *inventions* without adding discoveries.

The seventeenth section speaks of injunctions to prevent the violation of the rights of any *inventor*, but says nothing of any *discoverer*, shewing that the word *inventor* included all such *discoverers* as were contemplated by the Legislature as within the protection of the *patent laws.*

The eighteenth section provides "that whenever the patentee of an *invention* or *discovery* shall desire to extend his patent beyond the term of its limitation, he may make application," &c., and shall furnish a statement of "the ascertained value of the *invention*," and having failed to obtain from the use and sale of *his invention*, a reasonable remuneration, &c., he may have the term extended. Here it is evident that the word *invention* was understood as equivalent to *invention and discovery*, mentioned in the beginning of the section; and shows that the discovery contemplated was the discovery of something *new*—i. e. that did not exist before, and was used as synonimous with the word *invention.*

The remaining sections of the act do not use the word *invention* or *discovery.*

The act of March 3, 1839, (Pamphlet, ch. 88, p. 74,) section seventh, says that every person who shall have constructed any "newly *invented* machine, manufacture, or composition of matter prior to the application by the *inventor* or *dicoverer* for a patent, shall be held to possess the right to use, &c., the specific machine, &c., so made, &c.,

without liability therefor to the *inventor* or any other person interested in such *invention;* and no patent shall be held to be invalid by reason of such use, &c., except on proof of abandonment of such *invention* to the public," &c.

There is nothing further in this act tending to explain the meaning of the word *discovery* as used in the Constitution and Laws of the United States respecting patents for useful arts.

Upon consideration of the Constitution and Laws of the United States upon this subject, therefore, I think I may safely say, that the claimant in this case can build no argument upon the supposed difference between a discovery and an invention; for no discovery will entitle the discoverer to a patent which does not, in effect, amount to the contrivance or production of something which did not exist before, or in other words to an invention.

The patent claimed is *for the placing of the prepared blocks edgewise,* for the purpose set forth in the specification.

The placing of the blocks of ice edgewise, is not the contrivance or production of any thing which did not exist before. It is not an invention. It is not a discovery, because every body knew before that the blocks of ice might be placed upon their narrowest side; and it is asserted by the Commissioner in the grounds of his decision, and not denied in argument, that blocks of ice have been so placed; whether by accident or design is immaterial; the placing is not new. It is not an invention.

The discovery of a new effect of that which existed before is not the subject of a patent. Blocks of ice have been placed on edge before the alleged discovery by the claimant. If they were so placed with intent to retard their dissolution, I presume the claimant would at once abandon his claim. But the intent can be no ground of a patent. The claimant may be the first who placed blocks of ice on edge *with that intent,* but this cannot justify a patent for doing that which was often done without that intent. In truth the whole merit of the claimant is the discovery of a fact which existed long before, viz. that ice placed edgewise kept longer than when placed flatwise. This is a mere naked *discovery,* for which a patent cannot be granted. There is no invention, nothing contrived or produced which did not exist before.

It is, however, contended that although the discovery, merely as such, is not patentable, and although blocks of ice may have been often placed edgewise, yet "it will not be pretended that in vessels or in ice-houses ice had ever been stowed away upon the *system* adopted by Mr. Kemper." By "*system*" I suppose must here be meant *intent* or purpose—for the placing the ice on edge cannot, of itself, form a system. A system, as defined by Dr. Johnson, is "any complex use, or combination of many things acting together; a scheme which reduces many things to regular dependence or co-operation; a scheme which unites many things in order."

The patent, in the present case, is not asked for a *system,* but for the exclusive right to place blocks of ice on their narrowest side. The claim, therefore, obtains no support by calling it a *system;* nor

by calling it a "*plan*," as in the reasons of appeal, where it is asked, "Is the proposed *plan* unquestionably old?" What the writer meant by the word *plan* is not very obvious, but I presume he intended to refer to the placing of the ice *edgewise, with the intent* that it should thereby keep longer than if otherwise placed. He probably meant to include the *intent* with the *act;* but as before observed, if the thing done be not new, the intent cannot entitle it to a patent.

It is admitted in argument on behalf of the applicant, "that a discovery, taken abstractedly, is not patentable;" but it is contended "that if the thing discovered be practically applied to produce a new and useful effect, the manner of obtaining this end is patentable." Now let us apply this rule, or doctrine, to the present case. The thing discovered is the beneficial *effect* of the position of the ice—not the position itself. How is this *effect*, which is the thing discovered, applied by the applicant to produce a new and useful effect? and what is the new effect thus to be produced by the effect discovered? Whatever it may be, it must be produced by means that are new—by some *invention*—some contrivance or production of something that did not before exist. The beneficial effect of the position of the ice, is the retardation of its dissolution. No new and further effect is proposed. That retardation is the *ultimate* effect contemplated. No *new* means are intended to be used which can be the subject of a patent. A new effect from old means will not justify a patent for those old means. This case is, therefore, not within the rule or doctrine thus advanced to support it.

The patent to Mr. Tudor for filling the interstices between the blocks of ice with some non-conducting substance, is cited as a precedent for the present application. No judicial decision is produced affirming the validity of that patent, and it seems to me to rest upon very doubtful grounds; but it is to be presumed that the Commissioner who issued it, was satisfied that the means used were a new invention.

Mr. Dolland's patent for an improvement is also referred to, but there the means used were decided to be, as to him, a new invention, although Dr. Hall had, forty years before, constructed two telescopes upon *the same principle*, but had not pursued the matter and brought it into public use. That case has no analogy to the present.

In the reasons of appeal it is suggested that patents for *processes*, or *modes of procedure*, in preserving animal and vegetable substances by means extremely simple, have been granted in England and in this country; but as they are not particularly brought to my notice, I cannot say how far they may be considered as precedents to justify the present application. I presume that in all of them something new was invented; something more than the discovery of a fact or a principle, and the application of such fact or principle to some useful purpose by old means, or by means not newly invented.

It is also suggested in the reasons of appeal, that "the Commissioner is *bound* to issue a patent for the thing claimed, if on examination it shall not appear to him that the same had been invented or discovered by any other person in the country, prior to the alleged in-

vention or discovery thereof by the applicant, or that it had been patented or described, &c., as stated in the seventh section of the act of July 4, 1836; and that the *discovery* in question is not placed in either of the conditions that would justify the refusing of a patent, under the law.

But the seventh section refers to the sixth, by which it appears that a patent is to be issued only to a person who has discovered or invented some *new* and useful art, &c., or some *new* and useful improvement on any art, &c.

The Commissioner, therefore, is to decide in the first place, whether the invention is new, and whether it is the proper subject of a patent; and if he finds that it is not the proper subject of a patent, he is bound to refuse it, although it may not be liable to the particular objections specified in the seventh section.

It is also said in the reasons of appeal, that the professed rule of the office is "that where the question is at all doubtful, that a patent should be granted."

This rule, I suppose, must have been adopted when the applicant had no remedy if the Commissioner rejected his claim, and the decision of the Commissioner was affirmed by the Board of Examiners, under the seventh and sixteenth sections of the act of July 4, 1836—which last mentioned section gave the applicant a remedy by bill in equity, only in case the patent was refused on the ground that it would interfere with an unexpired patent previously granted. In all other cases of refusal, the applicant had no remedy—whereas, if the patent should be granted, its validity might be at all times questioned in the courts of law. It was reasonable, therefore, to adopt such a rule.

But now, by the tenth section of the act of March 3, 1839, if the patent be refused, for any cause, either by the Commissioner or the Judge, the applicant may still establish his right to a patent by a bill in equity.

The reason of the rule therefore fails, and I should not think myself bound by it if I thought this to be a case of doubt, which I do not.

Every patent is a monopoly, and nothing can justify it but the natural right of property which a man has in the products of his own labor and ingenuity. With this exception, it is in derogation of common right; and it should be strictly confined to the case excepted. Upon the whole, therefore, I am of opinion, and so decide, That the decision of the Commissioner of Patents, that the applicant, John F. Kemper, was not entitled to receive a patent for the manner of stowing ice by placing the blocks edgewise, was correct, and the same is hereby confirmed.

And I do hereby certify the same to the said Commissioner of Patents; and I further certify that having received an appeal and the petition herewith inclosed, of John F. Kemper, and the original papers named in the letter from the Commissioner of Patents of the 13th of February, 1841, herewith also inclosed, I ordered notice to be given, as appears in my order of the 17th of February, 1841, also herewith inclosed, which was returned to me on the 18th of Febru-

ary, 1841, with service acknowledged. I further certify that the parties appeared before me, at my chambers, on Monday, the 8th of March, 1841, when, by consent, the hearing was postponed to Monday, the 15th of March, when the applicant, by Dr. Thomas P. Jones, his Attorney, presented his written answer to the grounds of the Commissioner's decision, (which written answer is also herewith inclosed,) when the hearing was further postponed, by consent, to Wednesday, the 17th instant, and on that day further postponed until Friday, the 19th instant, when the parties attended, and the Commissioner filed his reply to the argument of Doctor Jones, which is also herewith inclosed, and the case was then submitted, without further argument. All which papers are herewith transmitted to the Commissioner of Patents, this 22nd day of March, 1841.

W. Cranch.

Cast-Iron Tiles.

The *Memorial de la Sambre* announces that a trial has just been made in the manufactories of Gougnies, to substitute plates of cast-iron for slates and tiles. In these first specimens seventeen plates of cast-iron of a certain shape cover a square metre, and this square metre weighs on an average twenty-two kilogrammes. The same extent covered by common slates weighs twenty-one kilogrammes, and by large slates nineteen kilogrammes, and the square metre of tiles weighs forty kilogrammes. Thus, on the ground of lightness alone, cast iron plates may bear competition with slates, and they have a decided superiority over tiles. The plates of cast-iron are sold at the establishment of Gougnies at thirty centimes a piece; two centimes more when they are required to be varnished, to protect them from the wet. The value of the plates, therefore, is five francs ten centimes the square metre, and varnished plates five francs forty-four centimes. The price of these cast-iron plates is therefore not exorbitant, particularly when it is considered that the use of plates of cast-iron prevents the annual expense of repairing, which in roofs of slate or tiles average a quarter, and sometimes a third, of the first cost. Besides, there is a saving of the nails which are used to join the slates. The iron plates are fixed merely by wooden laths. It is expected that this new invention will be of great service to the iron manufacturers; many other applications of iron it is expected will result from this.

Mining Review, Dec. 1840.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JUNE, 1841.

COMPUTED BY JOHN DOWNES.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.
☞For direct vision add 180°.☜

Day.	H'r.	Min.		Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	12	0	Im. (282)	Solitarii,	6	36°	57°
1	13	7	Em.			292	325
2	8	29	Im.	π Scorpii,	3.4	75	46
2	9	52	Em.			241	225
2	14	50	Im.	*m* Scorpii,	6	148	187
2	15	26	Em.			207	251
4			Im.	*p* Sagittarii, 5 below the horizon			
4	9	14	Em.			283	244

JULY, 1841.

Day.	H'r.	Min.		Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
5	11	18	Im. 21	Capricorni,	6	165	134
5	12	17	Em.			247	225
5	14	58	Im.	θ Capricorni,	5.6	70	83
5	15	47	Em.			359	22
16			Im.	ε Geminorum,	*invisible.*		
16	15	54	Em.			295	246
28	11	53	Im.	*y* Ophiuchi,	6	44	82
28	12	38	Em.			333	14
29	12	45	Im.	*g* Sagittarii,	5.6	175	209
29	13	19	Em.			226	265
31	12	37	Im. 351	Sagittarii,	6	31	48
31	12	42	Em.			24	43

Meteorological Observations for April, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	41	55	29.85	29.85	S. W.	Moderate.	.03	Cloudy—rain—clear.
	2	43	68	.80	.65	SE.S.	do.	.12	Lightly cloudy—do. do.—tornado
	3	38	50	.94	30.05	W.	do.		Clear—do
☉	4	36	47	30.10	.00	SE.	do.		Cloudy—do.
	5	45	55	29.60	29.74	W.	Brisk.		Cloudy--clear.
	6	44	54	.95	30.04	W.	do.		Cloudy--clear.
	7	45	57	30.10	29.90	W.SE.	Calm.		Cloudy—do.
	8	41	55	29.70	75	NE.	Moderate.	.05	Drizzle—flying clouds.
	9	45	68	.83	.60	S.	Brisk.		Cloudy—lightly cloudy.
	10	42	42	.70	.76	E.	do.	.23	Cloudy--snow.
	11	28	38	30.00	30.10	E.	Moderate.		Clear--do.
	12	32	32	.10	.00	E.	Brisk.	1.00	Snow—do.
☽	13	30	46	29.85	29.85	NW.	Moderate.		Cloudy--flying clouds.
	14	33	47	.75	.95	E.W.	do.	.75	Snow--flying clouds.
	15	30	47	30 27	30.35	W.	do.		Clear—do.
	16	30	56	.40	.41	SW.	do.		Clear—do.
	17	45	58	.10	.00	SW.	do.	.03	Drizzle—do—rain in night.
	18	58	58	29.50	29.60	SW.W.	Brisk.	.04	Cloudy—flying clouds.
	19	34	56	30.00	30.00	W.	Moderate.		Clear—do.
	20	41	50	.00	.00	SW.S.	do.	.22	Cloudy—rain.
⊗	21	48	55	29 85	29.84	NW	do.		Clear—do.
	22	41	49	30 00	30 00	NE.	Brisk.		Partially cloudy—cloudy.
	23	47	56	29.85	29.90	NE SE.	do.	.35	Drizzle--rain--cloudy.
	24	49	62	.97	.97	E.	Moderate.		Cloudy--do.
	25	53	63	.97	30.00	E.	do.		Cloudy—do.
	26	51	66	.90	29 84	E.S.	do.		Cloudy--clear.
	27	51	57	.56	.64	W.	do.	.36	Rain—clear.
☾	28	41	63	.90	.94	NW.	do.		Clear--do.
	29	42	45	.80	.50	W.S.	do.	1.25	Partially cloudy—rain.
	30	44	52	.05	.05	W.	do.	.06	Cloudy—drizzle.
	Mean	41.63	53.57	29.88	29.88			4.49	

	Thermometer.		Barometer.	
Maximum height during the month,	68.00	on the 2nd and 9th.	30.41	on the 16th.
Minimum " "	28.00	" 11th.	29.05	" 30th.
Mean	47.60		29.88	

									Hygrometer.					
	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
2	$6\frac{2}{3}$	$3\frac{2}{3}$	$3\frac{1}{3}$	$3\frac{2}{3}$	$4\frac{2}{3}$	$\frac{1}{3}$	.	.	....	.	....	....	.	1318
4	6	$4\frac{1}{3}$	3	$\frac{1}{3}$	$9\frac{1}{3}$	.	.	$\frac{2}{3}$	....	.	.....	....	.	1381
5														
6														
7	2	.	$12\frac{2}{3}$	.	$3\frac{2}{3}$	.	.	8	....	.	.....	....	.	1352
8														
9														
10	$5\frac{1}{3}$	$\frac{1}{3}$	8	$\frac{2}{3}$	$4\frac{1}{3}$	.	.	.	....	.	.....	....	.	1366
11														
12	$3\frac{2}{3}$	$1\frac{1}{3}$	$5\frac{1}{3}$	2	4	.	$6\frac{1}{3}$	$\frac{2}{3}$	....	.	.....	....	.	1317
13	4	.	$4\frac{2}{3}$	$2\frac{2}{3}$	$14\frac{1}{3}$	.	$\frac{1}{3}$	.	....	.	......	....	.	1328
14														
15	$3\frac{1}{3}$	$3\frac{1}{3}$	$\frac{1}{3}$	2	$13\frac{1}{3}$	$\frac{2}{3}$	$\frac{1}{3}$	.	....	.	.....	36.63	1	1324
16	$1\frac{2}{3}$	$1\frac{1}{3}$	$8\frac{1}{3}$	2	5	1	.	.	26.36	.	......	32.71	.	1334
17														
18														
19	.	.	$4\frac{2}{3}$	.	$16\frac{2}{3}$	.	.	.	....	.	......	....	.	1319
20	3	.	$7\frac{2}{3}$	$\frac{1}{3}$	$3\frac{2}{3}$	.	$1\frac{1}{3}$	.	....	.	.....	....	.	1320
21														
22														
23														
24														
25														
26														
27	$\frac{1}{3}$	.	$1\frac{2}{3}$	.	$9\frac{2}{3}$	.	$10\frac{2}{3}$	$3\frac{2}{3}$	....	.	.....	....	.	1322
28														
29														
30	4	$1\frac{1}{3}$	6	$1\frac{2}{3}$	2	$\frac{1}{3}$	7	$\frac{1}{3}$	25.81	3	.....	30.65	3	1374
31														
32	.	.	$20\frac{2}{3}$	.	.	.	.	$\frac{2}{3}$	....	.	.....	....	.	1337
33	1	$\frac{2}{3}$	5	$\frac{1}{3}$	$1\frac{1}{3}$	.	.	$20\frac{1}{3}$	....	.	.....	....	.	1325
34														
35	$3\frac{1}{3}$	.	$8\frac{2}{3}$	.	10	.	.	1	....	.	.....	....	.	1335
36														
37	2	$\frac{1}{3}$	$11\frac{1}{3}$	$\frac{1}{3}$	$7\frac{1}{3}$	.	$2\frac{2}{3}$	$1\frac{2}{3}$	....	.	.....	...	.	1323
38	5	7	$\frac{1}{3}$	$6\frac{1}{3}$	$6\frac{2}{3}$	.	.	1	....	.	.. .	....	.	1329
39	$4\frac{2}{3}$	$\frac{2}{3}$	$11\frac{1}{3}$	2	$\frac{1}{3}$	$\frac{1}{3}$	$3\frac{2}{3}$	$1\frac{2}{3}$	....	.	.....	....	.	1326
40	$2\frac{1}{3}$	.	$5\frac{2}{3}$	.	1	.	8	.	....	.	...	....	.	1336
41														
42	9	.	$\frac{2}{3}$	.	5	.	$4\frac{2}{3}$	.	....	.	......	....	.	1332
43	$\frac{2}{3}$	.	.	.	$14\frac{1}{3}$	.	.	$1\frac{2}{3}$	....	.	.....	....	.	1333
44														
45														
46	$2\frac{1}{3}$	.	$4\frac{1}{3}$	.	$8\frac{1}{3}$	.	1	.	....	.	.....	....	.	1441
47														
48														
49	3	$\frac{1}{3}$	3	.	$7\frac{1}{3}$	$\frac{1}{3}$	$3\frac{2}{3}$	$1\frac{1}{3}$	....	.	......	....	.	1339
50	4	.	3	.	$12\frac{2}{3}$	.	2	$1\frac{1}{3}$	....	.	......	....	.	1379
51	$5\frac{2}{3}$	.	$5\frac{1}{3}$	.	$1\frac{1}{3}$	.	.	.	....	.	......	....	.	1327
52														
53														

METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
DECEMBER, 1840.

Thermometer.

County.	Town.	Observer.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia,	Philadelphia,	G. P. Schively,	26.92	35.66	29.98	48.00	16.00	30.85	.	16.00	24.97	.
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	25.13	35.13	27.32	47.25	10.00	29.19	.	10.00	22.30	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,										
6 Monroe,	Stroudsburg,	A. M. Stokes,	20.55	32.22	26.17	50.00	5.00	26.31	11⅔	5.00	9.71	24
7 Pike,	Milford,	Ralph Bull,										
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,	17.00	23.33	19.45	37.00	1.00	19.93	.	1.00	15.87	.
10 Luzerne,	Wilkesbarre,	W. F. Dennis,										
11 Schuylkill,	Port Carbon,	P. C. Lyceum,	22.83	35.95	25.10	48.50	6.00	27.96	⅔	6.00	18.58	.
12 Berks,	Reading,	C. F. Egelmann,	24.26	32.19	26.87	46.00	11.00	27.77	.	...	...	.
13 Chester,	West Chester,	Wm. W. Jefferies,										
14 Delaware,	Haverford,	Haverford School,	25.82	32.41	29.04	49.00	13.00	29.09	3⅓	10.00	21.84	.
15 Lancaster,	Lancaster,	Conservatory of Arts,	24.19	35.56	27.60	49.00	12.50	29.12	.	11.00	20.97	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	27.51	32.23	30.42	43.00	20.00	30.05	.	17.00	25.23	.
19 Northumberland,	Northumberland,	Andrew C. Huston,	23.74	33.32	27.61	44.00	8.00	28.22	.	5.00	19.39	.
20 Columbia,	Danville,	C. H. Frick.										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Rinkead,	24.30	34.79	25.83	48.00	11.00	28.31	3⅓	....	....	.
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,										
29 Adams,	Gettysburg,	Prof. M. Jacobs,	22.54	34.05	26.71	47.00	8.00	27.76	.	8.00	20.13	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	23.87	34.70	28.90	50.00	8.00	29.16	⅔	....	....	.
32 Centre,	Bellefonte,	John Harris,	22.65	36.22	26.98	50.00	8.00	28.62	12⅔	....	....	.
33 Potter,												
34 M'Kean,	Smithport,	Richard Chadwick,	19.81	28.64	21.64	42.00	—4.00	23.36	.	—7.00	18.10	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	18.90	24.62	23.21	49.00	—3.00	22.24	1⅔	—3.00	17.50	3
37 Bedford,	Bedford,	Samuel Brown,	24.27	34.09	27.34	55.00	10.00	28.57	1	....	....	.
38 Somerset,	Somerset,	George Mowry,	24.77	31.95	27.14	50.00	4.50	27.95	1⅔	4.50	21.09	2
39 Indiana,	Indiana,	Richard White,	27.77	32.68	25.42	50.00	12.00	28.62	.	....	....	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	C. S. Brown,	29.95	35.19	33.26	49.00	10.00	32.80	.	10.00	29.32	.
42 Venango,	Franklin,	Wm. Connely,	21.48	31.23	25.97	43.00	—2.00	26.23	.	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weethee,	27.22	35.58	29.10	56.00	7.00	30.63	.	....	....	.
46 Green,												
47 Washington,	Cannonsburg,	Prof. A. H. Campbell,										
48 Alleghany,	Pittsburgh,	J. P. Bakewell,	30.77	35.69	31.97	55.00	9.00	32.81	⅔	....	....	.
49 Beaver,	Beaver,	James Allison,	27.42	32.61	29.40	50.00	3.00	29.81	1⅓	....	....	.
50 Butler,	Butler,	Jacob Mechling,	28.03	32.45	31.55	48.00	8.00	30.68	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	J. Limber,										
53 Erie,	Erie,	Park & Reid,										

Barometer. — Weather.

County.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	30.11	30.10	30.11	30.53	29.53	30.11	.	16	15	.	....	....	....	..	......
3 Bucks,	30.03	30.02	30.03	30.47	29.46	30.03	.	14⅓	15⅓	1⅓	2	6	1	..	4.256
6 Monroe,	29.51	29.55	29.55	29.80	29.20	29.54	9⅔	5⅓	12⅓	13⅓	1	4	....	..	3.083
9 Susquehanna,	28.11	28.12	28.12	28.30	27.80	28.12	.	10⅓	20⅔	.	2	9	....	..	......
11 Schuylkill,	29.35	29.36	29.37	29.73	28.79	29.36	⅔	11	19⅓	⅔	1	11	....	..	2.328
12 Berks,	29.83	29.84	29.83	30.30	29.22	29.83	.	11	20	.	3	6	....	..	3.843
14 Delaware,	29.59	29.56	29.58	29.98	29.14	29.58	.	15	16	.	2	6	....	..	3.305
15 Lancaster,	29.47	29.45	29.47	29.91	28.78	29.46	.	16⅔	14⅓	.	2	6	....	..	4.230
18 Dauphin,	29.81	29.80	29.80	30.20	29.30	29.80	.	14	17	.	1	6	1	..	3.257
19 Northumberland,	29.43	29.41	29.43	29.70	28.75	29.42	.	4⅔	26⅓	.	2	9	....	..	......
26 Juniata,	29.52	29.53	29.54	30.00	28.87	29.53	3⅓	8⅓	19	3⅔	....	....	....	..	......
29 Adams,	29.37	29.35	29.36	29.75	28.72	29.36	.	14	17	.	....	....	....	..	.....
31 Huntingdon,	29.33	29.31	29.32	29.76	28.66	29.32	⅔	9	22	.	1	8	....	..	1.522
32 Centre,	29.30	29.25	29.30	29.71	28.71	29.28	11⅓	4⅓	13	13⅔	....	....	....	..	......
34 M'Kean,	27.94	27.93	27.94	28.30	27.30	27.94	.	4	27	.	1	8	1	..	2.301
36 Cambria,	27.74	27.77	27.73	28.14	27.07	27.75	1⅔	2	27⅓	1⅔	1	9	....	..	2.183
37 Bedford,	29.19	29.17	29.19	29.55	28.50	29.18	1	8	22	1	1	5	....	..	......
38 Somerset,	27.88	29.87	27.87	28.20	27.19	27.87	1⅔	4⅓	24⅔	2	1	12	....	..	3.042
39 Indiana,	28.56	28.56	28.59	29.00	27.90	28.57	.	3	28	.	6	7	....	..	1.460
41 Warren,	28.71	28.70	28.71	29.22	28.08	28.71	.	5	26	.	....	....	....	..	......
42 Venango,	28.93	28.93	28.95	29.40	28.19	28.93	1⅔	4⅔	24	2⅓	....	7	....	..	1.832
45 Fayette,	29.06	29.02	29.02	29.30	28.35	29.03	.	11⅔	19⅓	.	2	7	....	..	1.526
48 Alleghany,	29.22	29.15	29.20	29.58	28.38	29.19	⅔	4⅔	26	⅓	3	6	....	..	1.965
49 Beaver,	29.39	29.37	29.38	29.80	28.60	29.38	1⅓	5	24⅔	1⅓	4	6	1	..	......
50 Butler,	28.72	28.75	28.76	29.10	28.10	28.74	.	8	23	.	1	6	....	..	1.916

Winds.

County.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
1 Philadelphia,	2⅔	1	2⅓	.	⅓	.	.	.	⅔	1⅔	6⅔	3⅔	3⅓	3⅔	4⅔	⅓	.	.
3 Bucks,	⅓	1⅓	3⅔	⅓	.	.	⅓	.	1	⅓	6	4⅓	3	⅓	9⅓	.	.	⅔
6 Monroe,	1	.	1	.	2⅔	.	.	.	.	.	2	.	12⅔	.	3⅔	.	.	8
9 Susquehanna,	8	.	.	.	.	.	.	.	4⅓	.	5⅓	⅓	8	⅔	4⅓	.	.	.
11 Schuylkill,	1⅔	.	4⅔	⅓	.	⅓	⅔	.	.	.	3⅔	1⅓	5⅓	2	4	.	6⅓	⅔
12 Berks,	⅓	.	2⅔	.	1⅓	.	4	.	.	.	4	.	4⅔	2⅔	14⅓	.	⅓	.
14 Delaware,	⅓	2⅓	2⅓	1	.	⅓	⅔	⅓	.	⅓	3⅓	3⅓	⅓	2	13⅓	⅔	⅓	.
15 Lancaster,	1⅔	⅔	3⅔	⅔	.	.	⅔	.	3	1⅓	1⅔	1⅓	8⅓	2	5	1	.	.
18 Dauphin,	1⅔	.	2⅔	.	1	.	3⅔	.	⅔	.	.	.	4⅔	.	16⅔	.	.	.
19 Northumberland,	6	.	3⅓	.	2⅓	.	⅔	⅓	2⅓	.	3	.	7⅔	⅓	3⅔	.	1⅓	.
26 Juniata,	.	.	3⅓	.	⅓	.	1⅓	.	.	.	⅓	.	1⅔	.	9⅔	.	10⅔	3⅔
29 Adams,	⅓	1⅓	2⅓	.	⅔	.	⅓	.	3	⅓	4	1⅓	6	1⅔	2	⅓	7	⅓
31 Huntingdon,	.	.	.	.	9⅔	.	.	.	.	.	.	.	20⅔	.	.	.	.	⅔
32 Centre,	1	.	⅔	.	⅓	.	.	.	⅓	.	1	⅔	5	⅓	1⅓	.	.	20⅓
34 M'Kean,	.	.	⅓	.	7⅓	.	⅓	.	.	.	3⅓	.	8⅔	.	10	.	.	1
36 Cambria,	.	.	1⅓	.	2⅓	.	⅔	⅓	⅔	.	2	⅓	11⅓	⅓	7⅓	.	2⅔	1⅔
37 Bedford,	.	2	.	.	.	.	⅔	1⅔	.	⅓	5	7	⅓	6⅓	6⅔	.	.	1
38 Somerset,	.	.	⅓	.	2⅔	⅓	.	⅓	1	.	4⅔	⅔	11⅓	2	⅓	⅓	3⅔	1⅔
39 Indiana,	1⅓	.	.	.	.	.	1⅓	.	1⅓	.	12⅓	.	5⅔	.	1	.	8	.
41 Warren,	5	.	.	.	.	⅔	3	.	2	1	9	.	⅔	.	5	.	4⅔	.
42 Venango,	.	.	.	.	.	.	9⅔	.	.	.	⅔	.	.	.	14⅓	.	.	1⅔
45 Fayette,	.	.	2⅓	.	.	.	2⅓	.	⅓	.	12⅓	.	4⅓	.	8⅓	.	1	.
48 Alleghany,	.	.	2⅓	⅓	2⅔	⅓	3⅓	.	3	.	3	⅓	3	.	7⅓	⅓	3⅔	1⅓
49 Beaver,	⅔	.	2⅔	.	1	.	2⅓	.	1⅓	.	4	.	3	.	12⅔	.	2	1⅓
50 Butler,	.	.	2	.	6⅓	.	⅓	.	.	.	15⅔	.	5⅓	.	1⅓	.	.	.

Hygrometer.

County.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	....	.	....	....	.	1318
3 Bucks,	....	.	.....	....	.	1381
6 Monroe,	....	.	.....	....	.	1352
9 Susquehanna,	....	.	.....	....	.	1366
11 Schuylkill,	....	.	.....	....	.	1317
12 Berks,	....	.	......	....	.	1328
14 Delaware,	....	.	.....	36.63	1	1324
15 Lancaster,	26.36	.	......	32.71	.	1334
18 Dauphin,	....	.	......	....	.	1319
19 Northumberland,	....	.	......	....	.	1320
26 Juniata,	....	.	......	....	.	1322
29 Adams,	25.81	3	.....	30.65	3	1374
31 Huntingdon,	....	.	.....	....	.	1337
32 Centre,	....	.	.....	....	.	1325
34 M'Kean,	....	.	.....	....	.	1335
36 Cambria,	....	.	.....	....	.	1323
37 Bedford,	....	.	.. ..	....	.	1329
38 Somerset,	....	.	.....	....	.	1326
39 Indiana,	....	.	...	....	.	1336
41 Warren,	....	.	.....	....	.	1332
42 Venango,	....	.	.....	....	.	1333
45 Fayette,	....	.	.....	....	.	1441
48 Alleghany,	....	.	......	....	.	1339
49 Beaver,	....	.	......	....	.	1379
50 Butler,	....	.	.....	....	.	1327

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AMERICAN PATENTS, LIST OF, WITH EDITOR'S REMARKS.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania

AND

MECHANICS' REGISTER.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

BY THOMAS P. JONES, M. D.

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JOURNAL

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OF THE

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AND

MECHANICS' REGISTER.

JULY, 1841.

Practical & Theoretical Mechanics & Chemistry.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, appointed to ascertain, by experiment, the Value of Water as a Moving Power.

[CONTINUED FROM PAGE 369, VOL. I.]

II. UNDERSHOT WHEELS.

1. *On the ratio of Effect to Power.*—The experiments on undershot wheels were made with wheel No. I., and of course with centre buckets. The aperture was on a level with the tail-way, and the gate closing it was of the form *b*. (Fig. II. Plate IV. Vol. viii., Jour. Frank. Inst.) In the first set of experiments, there were air-vents in the soling of the wheel, through which the water, particularly at high heads, was forced violently, and wasted; and the series is accordingly omitted in the following table. This wasting of the water was from the inadequate size of the vents, as when half the soling of the wheel was removed it did not occur. The heads, apertures, and ratios of effect to power, occupy the successive columns of the table.

TABLE THIRTIETH.

Ratio of effect to power in the undershot wheel. Taken from tables S and T. (Vol. ix, Jour. Frank. Inst. p. 154–7.)

Table.	Head. Feet.	Aperture. Inches.	Ratio of effect to power.	Ratio for different heads.	Mean ratio.	Remarks.
S.	23.00	1.00	.294	.294		
"	20.75	0.75	.275			
"	"	1.00	.295	.285		
"	17.75	0.75	.287			
"	"	1.00	.292	.289		
"	4.67	1.75	.262			
"	"	2.00	.268			
"	"	2.25	.283	.271	.285	Half of soling removed.
T.	20.75	1.00	.296			
"	"	1.25	.300	.298		
"	4.67	1.75	.276			
"	"	2.50	.305	.290		
"	3.00	2.00	.277			
"	"	2.50	.272	.274	.287	Wheel removed from breast.
Mean ratio for high heads,					.292	
" " low "					.278	
Average,					.285	

The average ratio of effect to power appears from this table to be .285. The ratios for the higher heads are decidedly, though not considerably, greater than for lower ones, probably on account of the greater proportion which the effect lost by the water escaping between the wheel and tail-way bears to the whole effect, and which the width of the aperture bears to the head in low heads. All those heads in which the motion of the water was affected by the mode of supplying the forebay (see Plate I. Vol. vii.) have been excluded from the table.

Taking the average ratio of the undershot wheel for comparison with that of the overshot, we find a proportion of 2.98 to one in favour of the latter wheel, approaching nearly to the ratio of three to one.

While in the experiments of Smeaton the overshot wheel appears to have been underrated, the undershot coefficient agrees very nearly with that just deduced; hence our comparison is more advantageous to the overshot wheel than his, in the proportion of 2.98 to 2.

The ratio of effect to power being considered as constant, it follows that *in a given undershot wheel the absolute effect is, under all heads, as the head of water.*

The virtual head wherever the flow of water is regular, is proportional to the real head; hence for a given form of gate, the rule which

is stated is general. When by varying the form we change the velocity of efflux, the effective head varies in the ratio of the square root of the velocity. In the case actually before us, the gate *b* is the one of the four forms used in different experiments which gave the greatest effective quantity of discharge.

It may be satisfactory to show that the head which would result from a calculation of the height due to the velocity of discharge, or virtual head, bore in these experiments a sensibly constant ratio to the real head, as has just been asserted.

The following table, containing the ratios of the observed velocities of the water, obtained from tables R, S, and T, (Jour. Frank. Inst. vol. ix, p. 154–7,) with the velocities calculated upon the heads above the aperture, will serve to show that these ratios vary within moderate limits, which are no doubt those within which the circumstances of the experiments may have varied without being detected.

TABLE THIRTY-FIRST.

Showing the ratio of the actual to the theoretical discharge under different heads. Gate b, undershot.

Table.	Head.	Ratio of actual to theoretical velocity.	Table.	Head.	Ratio of actual to theoretical velocity.	Table.	Head.	Ratio of actual to theoretical velocity.
	Feet.			Feet.			Feet.	
R.	14.75	0.82	S.	23.00	0.79	T.	20.75	0.78
"	12.00	0.83	"	20.75	0.75	"	4.67	0.79
"	8.00	0.95	"	17.75	0.75	"	3.00	0.80
"	2.00	0.84	"	4.67	0.79	"	2.00	0.77
			"	2.00	0.78			

It is plain, from the manner in which these results vary, as well as from the amount of variation, that there is no sufficient ground to reject the actual heads in favour of heads calculated from the velocities of impulse.

The calculation of the effect by using the actual head, has, therefore, been preferred by the Committee, as more simple than the reference to a virtual head. An examination of table thirtieth will show that except in one case the ratio of effect to power is greater with a greater aperture. This does not arise from any difference in the actual velocity of the water compared with the velocity due to the head,

which might accidentally show some such relation. If the effects were corrected, by taking the virtual heads instead of the real heads, the ratio would rather be increased than diminished. It is necessary to recognise it as a true effect whatever may be its cause.

The truth of these remarks will be rendered more apparent by the following table, in which the actual heads and apertures are registered; the proportional discharges under the same head, but with varied apertures, are compared, and the effects as observed are also compared. Further to show that accidents in the velocity of discharge have not produced an apparent law, the virtual heads due to the velocities are calculated, and the ratios before obtained of effects are corrected according to these heads. A true comparison of effects under the same heads, but with different quantities of discharge, thence results.

TABLE THIRTY-SECOND.

Comparison of the relative effects under the same head, and with different quantities of water.

Table.	Head. Feet.	Aperture. Inches.	Ratio of quantities discharged.	Ratio of effects.	Virtual head. Feet.	Ratio of effects corrected by virtual head.
S.	4.67	1.75	1.00	1.00	3.08	1.00
	"	2.00	1.20	1.23	3.00	1.27
	"	2.25	1.35	1.46	2.70	1.66
T.	20.75	1.00	1.00	1.00	12.69	1.00
	"	1.25	1.10	1.13	12.50	1.16
	4.67	1.75	1.00	1.00	3.13	1.00
	"	2.54	1.45	1.63	2.70	1.89
	3.00	2.00	1.00	1.00	1.88	1.00
	"	2.50	1.17	1.14	1.91	1.12

It will be observed in this table that only those experiments have been used in which the aperture was considerably varied. In the first set we have for an increase of 35 per cent. in the quantity of discharge, one of 66 per cent. in the absolute effect, and at a mean with an increase of quantity from 1 to 1.25; the effects increase from 1 to 1.42, or the increase of absolute effect is greater than that of quantity in the proportion of 1.11 to 1. We must admit, then, as a result of experiment, that an increase in the ratio of power to effect may be obtained by an increase in the quantity of water expended, at least under the circumstances in which the water was delivered to the wheel in these experiments. The physical cause of this effect is doubtless the same as that referred to in page 363, Vol. ii., new series, as producing a similar effect in the velocity of an overshot wheel.

By comparing the ratios of power and effect, corresponding to the table just given, it will be found that *when the quantity is increased at a mean twenty-five per cent., the ratio of effect to power is increased but two per cent.*

2. *On the relative velocity of the wheel and water for an undershot wheel.*—The ratio of the velocity of the wheel to that of the water has been deduced in the following table, taken from tables R, S, and T.

TABLE THIRTY-THIRD.

Showing the relative velocity of the wheel and water in an undershot wheel.

Table.	Head.	Velocity of water.	Velocity of wheel.	Ratio.
	Feet.	Feet.	Feet.	
R.	14.75	25.38	10.86	.428
	12.00	23.01	10·02	.435
	8.00	21.77	11.16	.512
	2.00	9.48	5.92	.624
S.	23.00	30.34	14.46	.477
	20.75	27.32	14.87	.545
	17.75	25.29	13.97	.552
	4.67	13.73	7.68	.560
	2.00	8.86	5.66	.639
T.	20.75	28.58	14.80	.518
	4·67	13.70	7.32	.534
	3.00	11.06	6.26	.565
	2.00	8.73	5.43	.622
			Mean,	.539

This table gives for the mean ratio very nearly what was before obtained in the overshot wheel.

The ratio of the velocity of the wheel to that of the water is nearly nine-sixteenths.

The relative velocities in Smeaton's experiments varied between the proportions of one-third and one-half. Oliver Evans gives nearly two-thirds as the result of his practice. It is worthy of remark that Waring's Theory of Undershot Wheels gives one-half for the relative velocities of the wheel and water.*

A close examination of this table would seem to warrant the inference that as the heads increase, the ratio of the velocity of the wheel to that of the water decreases. This, however, we apprehend is not a fair deduction. The results in relation to the velocity of the

*Am. Philos. Trans.—old series. Vol. iii, p. 147.

wheel seem by no means so regular as those relating to the proportion of effect to power; but in general it will be seen that where the aperture is increased with a given head, and only the low heads admitted of any considerable increase without throwing too much water against the wheel, the ratio of the velocity of the wheel to that of the water is usually increased. It also appears by the tables that only the larger apertures were used under the low heads, hence the experiments are not precisely comparable, a large aperture giving a greater velocity than a small one would have done. Sometimes the actual velocities of the water, (deduced from the quantities discharged) appear to have increased by an increase in the aperture; but in general the reverse is the case, as will be seen by the following table.

TABLE THIRTY-FOURTH.

Showing the velocity of the water with different apertures and under the same head.

Number.	Head.	Width of aperture.	Velocity of water.	Number.	Head.	Width of aperture.	Velocity of water.	Number.	Head.	Width of aperture.	Velocity of water.
	Feet.	Inches.	Feet.		Feet.	Inches.	Feet.		Feet.	Inches.	Feet.
1	20.75	0.75	25·50	5	4.67	1.75	14.08	10	4.67	1.75	14.21
2	"	1.00	29.14	6	"	2.00	13.41	11	2.50	2.50	13.20
3	17.75	0.75	24.39	7	"	2.25	13.07	12	3.00	2.00	11.01
4	"	1.00	29.19	8	20.75	1.00	28.69	13	"	2.50	11.12
				9	"	1.25	28.08				

In the first four experiments an increase of velocity attended an increase of opening, in the last two a very slight increase, and in all the others a decrease. As these irregularities run through the series, it would not be proper to base a law upon the mean result.

A comparison of the ratio which the actual discharge bore to the theoretical discharge, with different heads and openings, would not be more satisfactory. While it abundantly appears that an increase of quantity up to a certain point slightly increases the apparent velocity, there is not sufficient reason to deduce a law as to the increase of the latter element by an increase of the former; a conclusion entirely confirmed by general reasoning as to the effect produced by the physical cause to which these phenomena have been satisfactorily traced.

3. *On the effect of air vents in undershot wheels.*—At low heads

air vents are neither an advantage nor disadvantage, but when the water has considerable velocity they produce a waste, from the violent forcing of water through them with the escaping air. The result may be seen by the following tabular view from R, (vol. ix, p. 154,) in which the ratios diminish as the head increases, except in one instance, when the falling off was so rapid as to interrupt the flow.

TABLE THIRTY-FIFTH.

Centre buckets with air vents in an undershot wheel.

	Head.	Aperture.	Ratio of effect to power.
	Feet.	Inches.	
1	14.75	0.75	.273
2	12.00	1.00	.284
3	8.00	1.50	.266
4	2.00	2.00	.298

The mean ratio for the three higher heads is .274, which is less than the ratios for the higher heads in table twenty-third, in the proportion of 292 to 274, or of 1.07 to 1.

When a sufficient portion of the soling was removed to allow the free and gradual escape of the air, the water was not forced over the soling, even at high heads, and the ratios were raised at high heads, as may be seen in table thirtieth.

4. *On the effect of running an overshot wheel near to a breast.*—Wheel No. I. was in the first two series of experiments at the overshot aperture, retained in the place which it had occupied in the experiments upon the overshot and other apertures, that is, close to the breast. It was subsequently removed six inches from the breast, and a new set of trials made, under different heads.

A comparison of the results when running close to the breast, and when removed from it, is given in the following table, containing experiments from tables S and T, (Jour. Frank. Inst. vol. ix., p. 154–7.) made under the same heads.

TABLE THIRTY-SIXTH.

Comparison of the effect of an undershot wheel running close to a breast and removed from it. Tables S and T.

Head above the bottom of gate.	Head and fall.	Ratio of effect to power.	
Feet.	Feet.	With breast.	Without breast
20.75	20.75	.285	.298
4.67	4.67	.271	.290
2.00	2.00	.253	.281
	Mean,	.270	.290

The advantage in every case is in favour of the removal of the wheel from the breast, and at a mean in the ratio of 1.074 to 1.

[TO BE CONTINUED.]

Account of the Explosion of the Boilers of the Steamboat Henry Eckford. By Thomas Ewbank.

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen.—You have doubtless noticed the newspaper accounts of the explosion of the boilers of the tow-boat *Henry Eckford*, on the evening of the 27th ult., at one of the docks of this city. The following testimony was adduced before the inquest held the next day over the remains of the only person killed. His death is believed to have been caused by a mass of lead driven violently against his head. It formed part of the sheets upon which the exploded boilers were bedded, and was found lying near him. The Captain of the Eckford was wounded, but the engineer and firemen, though close to the boilers, escaped unhurt. All things considered, it is truly wonderful that more lives were not lost on the boat, the surrounding vessels, and on the docks.

Coroner's Inquest.—An inquest was held upon the body of Amos Belshow, late of Palermo, Oswego county, who was killed by the explosion of the boiler on board the tow-boat Henry Eckford, on Tuesday evening.

The first witness examined was Solomon S. Patchen, master of the canal boat Henry, to which the deceased belonged. The Henry was lying on Tuesday evening at the foot of Cedar street, and the Eckford came there to tow her round into the East river. Witness and deceased were making the Henry fast to the Eckford when the explosion took place; the Eckford had been letting off steam, and the

explosion occurred almost the moment the escape valve was shut. The body of the deceased was found on board the Henry.

Mr. Isaac Newton, one of the owners of the tow-boat, deposed that she was built in 1824—that she had a completely new boiler about six years ago—that last fall she was inspected and licensed by the United States Inspector, and that his certificate of her good order was on board—that the boilers were overhauled and stripped about a year ago.

Mr. Newton on his further examination stated, that the Eckford was 150 tons burthen, the engine was a compound engine, called "Wolf's Engine," twelve inch high pressure cylinder, and twenty-four inch low pressure, and condensed its own steam—the boilers about thirty inches diameter without return flues, about eighteen feet long—did not remember the thickness of the iron in the boilers. The safety valves were weighted at 150 lbs. for ten years previous to the boat having been used in the harbour, since that they have been reduced, and consequently the pressure reduced.

Mr. George House who has been in the employment of the proprietors of the line of tow-boats to which the Eckford belonged, as chief engineer, for ten or fifteen years past—deposed that he was for seven or eight years on board the Eckford as engineer—left her in 1834—considered her a safe boat then, and ever since—she never exploded before—she had new boilers in 1829 or 1830 made under the inspection of witness, at the request of the proprietors—the iron was thoroughly tested—the sheets used were all gauged—the sheets were plump quarter inch, called No. 1, which is the strongest boiler iron used.

Mr. House further deposed that the boilers were eleven and a half years old—have been frequently repaired since—has known similar boilers to wear fifteen years—did not see a certificate of inspection on board the Eckford since the last repairs.

Charles Maxton, the engineer, deposed that he had been employed on board the Eckford since the 25th of March last—that he had examined her machinery, and considered it perfectly competent for the business she was engaged in—that he did not, however, "consider her a safe boat for a heavy head of steam"—that he was on board the boat on the evening of the accident—superintended the getting up of the steam, which occupied about two hours and a half—the means by which he judged of the pressure, was by a weight hung on a lever—witness had examined the weight several times whilst the boat was lying at the dock—the boat had been lying at the dock about twenty minutes when the explosion took place—when the boiler burst, the pressure was about fifty pounds—witness considered that amount of pressure perfectly safe—witness also examined the water

and found it in his opinion sufficient—the explosion took place almost immediately after stopping letting off steam—at the time of the explosion, witness was standing by the engine room, having at that moment tried the water by the gauge cock—never heard any person interested in the boat express any fears of her safety.

Professor James Renwick was examined, and deposed that he was acquainted with the principle of "Wolf's steam engine," considered it as safe as any other—the risk depends upon the boiler—witness heard the testimony of the engineers, and so far as their management of the boat was concerned, did not think them chargeable with carelessness—ten years ago, English iron was regarded as the best for boilers—American iron is now considered superior—a boiler of the construction described by preceding witnesses would last a dozen years if carefully repaired—the cylinder form is the simplest and strongest—the flues are the weakest part of the boiler, and one made without return flues is safer than one with them—the diameter was within the size considered safe, being thirty inches. Witness thinks 150 lbs. to the inch beyond a safe limit, but does not think that a dangerous explosion would be likely to take place at 75 lbs.—considered 104 lbs. the maximum pressure that would be prudently employed—witness considered the boiler calculated from twenty-five to forty pounds the safest kind of boiler in use.

Mr. John Clarke, one of the steamboat inspectors appointed under the law of 1838, was next examined. He deposed that he, in conjunction with his associate, Elisha S. Bunker, inspected the Eckford three or four times—the last occasion was on the 1st of October, 1840—a certificate of her competency was then given—would have given her a certificate at that time as a safe vessel for conveying passengers—the law requires an inspection of steamboats once in every six months—intended inspecting the Eckford in a few days and went to look for her on last Saturday for that purpose—the law requires the inspector's certificate to be hung up in a conspicuous place on board the boats—was informed at the time of the inspection that the Eckford carries fifty or seventy-five pounds—considered that perfectly safe—the usual mode of inspecting the boiler of a steamboat is to examine it by looking through the furnace door—witness is a practical engineer—has been so for upwards of thirty years.

After the testimony has been gone through, the Coroner called the attention of the jury to the great importance of the case, and reminded them that the great object of the tedious investigation before them was to ascertain whether the steamboat was sea-worthy, and had all her machinery, boilers, &c., in perfect repair and order, and also if any blame was to be attached to the captain or engineer, or other

persons engaged in the management of the boat, for culpable negligence, or ignorance on their part.

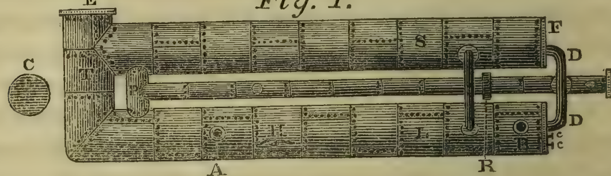
The jury returned the following verdict:—"The jury find that Amos Belshow came to his death by the accidental explosion of the boiler of the steamboat Henry Eckford, on the 27th of April inst. The jury believe that no blame can be attached to the owners, agents, captain, or engineers of the boat, it having fully appeared in evidence that said boat had recently undergone sufficient repairs—and the jury consider that if negligence is chargeable to any persons, it must be to the inspectors appointed by the Government of the United States, who had omitted to inspect the boat and engine, when duly notified by the agent of the owners that said boat was waiting their inspection."

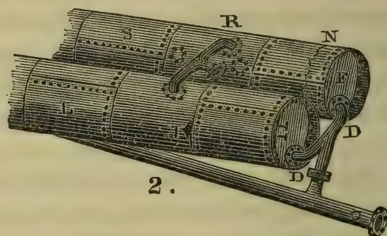
With a view to further the object of the Committee and thereby to subserve the interests of science and of humanity, I have endeavoured to procure such additional information as appeared necessary to understand the whole case. With permission of the person in charge of the boat, the engineer furnished me with three small portions of the boiler, taken from different parts of the end near the chimney; these, with the accompanying sketches and remarks, will enable the Committee to judge of the condition of the boilers, and to comprehend their construction and arrangement—and, with the preceding testimony, to arrive at a pretty correct conclusion respecting the cause of the disaster.

At the time the explosion took place I happened to be in the immediate vicinity, and hastening on board had an opportunity of observing its effects until dark, when the boat, supposed to be in a sinking condition, was removed. It would be difficult, if not impossible, adequately to describe the scene. Portions of the vessel and loads of fire wood that had been blown from her deck, or projected with the chimney and fragments of the engines and boilers into the air, were floating around. Nearly every thing but the heaviest parts of the machinery was swept off into the river, or upon the docks; while such as remained exhibited terrible proofs of the power that is developed in steam. The boilers, which probably weighed four tons, were raised from their bed and thrown nearly thirty feet towards the stern, bearing before them engine house, engine, cranks, wheels, and shafts, &c., as if these had never been secured to either the frame work or beams. So great was the force with which the engine was struck that the large cylinder, bereft of both top and bottom, and not a particle of either flanch remaining upon it, was hurled twenty feet further than the boilers themselves—while the massive cross-head, with the top of the cylinder, the piston and piston rod attached, were thrown several feet further. About two feet of the small cylinder with the

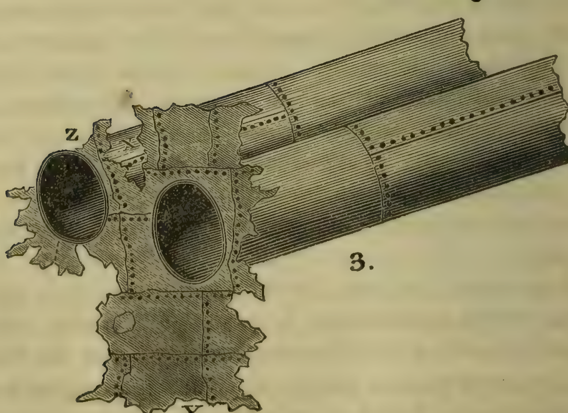
piston and rod within it was leaning against the end of one of the boilers. The cast-iron end of the starboard boiler (marked F in figs. 1 and 2,) was blown into the Captain's office near the stern of the boat, a distance of forty-six feet from its original position on the deck; and although two inches thick, was broken in two, both pieces were drawn out from among the bedding while I was present. But it was towards the bows of the vessel, where the most violent effects had taken place, and where nothing was left to indicate the force which had thus cleared all before it. It was here the chimney was located, (C in fig. 1,) but not a particle was left, the whole was blown into the air and then it fell into the river.

Fig. 1.





2.



3.

Nothing remained of the short cross boiler, (marked T in fig. 1) to which the ends of the two long ones were united, with the exception of such portions as are shown at fig. 3, and these were straightened out as represented.

The destruction of some, and the displacement of nearly all the machinery, rendered it difficult for a person not previously acquainted with the boat to detect (from the wreck before him) the mode by which the boilers were connected, or the arrangement for feeding them. It was not till the day after the explosion that I became aware of these and some other particulars. It is unnecessary to say any thing here respecting the engine, as its peculiarities are noticed in the testimony before the coroner. I may merely observe that the large cylinder was twenty-four and a half inches in diameter, and that both pistons had metallic packing.

The Henry Eckford had two wrought iron cylindrical boilers—see fig. 1, which represents their upper surfaces as seen from above, and as they appeared before the explosion. They were ranged fore and aft upon the middle of the deck—were nineteen feet long, thirty inches in diameter, and were placed eighteen inches apart. The furnace and fire door were towards the stern of the vessel, and the chimney C, was near the bows. The ends of the boilers over the fire were of cast iron, and connected at their lower parts by the feed pipe D D. R is the steam pipe with a branch and flanch at right angles, to which the one that led to the engine was connected. C C, the gauge cocks. The opposite ends of the boilers were united to a short one T. The larboard boiler L, being connected by a species of elbow joint, while the junction with the other was at the side, as represented. The open part of the short one being closed by a cast-iron end E. Besides being thus connected at their extremities, a passage from the interior of one boiler to that of the other, was formed below the water line, by a short pipe P, nine inches in diameter; and to the middle of this was joined another, O O, which was continued through the furnace and fuel beyond the fire door, where the feed pump was connected to it. This long tube was named *the heater;* its object being to heat the supply water before the latter entered the boilers. The front part of O O, passed through the furnace *below* the pipe D D, to which it was connected by a short vertical one, which I have endeavoured to represent at fig. 2.

There were two valves on the larboard boiler, A B fig. 1. The latter was one inch and three-quarters in diameter. The lever, weight, plug and rod were blown off and lost; nothing but the seat of the valve being left. The other one, A, was two and one-quarter inches in diameter, the distance between the centre of the fulcrum and that of the valve three and a half inches, and the lever four feet long; the weight is lost. As the upper edge of the lever had no notches or other graduated marks, and as the head of the valve rod had only a plain socket through which the lever was loosely slipped, it would

seem that the pressure of the steam could not have been very accurately ascertained, but must have been in a great degree guessed at. The small valve was close to the end of the boiler; it was formerly weighted to blow off at 150 lbs. on the inch, but at the time of the explosion, according to the engineer's account, at fifty pounds. It was named the tell-tale, and when steam escaped from it the other one was opened to let off the excess. It will be perceived that both the safety valves and gauge cocks were attached to the same boiler; no opening being in the starboard boiler S, except for the steam and feed pipes.

The present condition of the boilers may easily be stated. The part T, as already observed, was blown off, leaving the ends of L and S entirely open, with fragments hanging round them. These fragments show that the most part of T was greatly worn, and the texture of the metal deteriorated. Along the edge at Y (fig. 3) is was reduced from one-fourth of an inch, its original thickness, to one-twentieth of an inch, and even less in some places. The specimen No. 1 is from this part. No. 2, a piece that is only two and three-quarter inches in length, and not one and a half in width, exhibits the same or nearly the same extremes of thickness, and was taken from near the place marked X, while the largest specimen is from Z. The lines of separation are, in all instances, through the sheets, and not in the lines of the rivets; this circumstance may be accounted for from the fact that the heads of the rivets protected the metal over which they extended from corrosion, as seen in specimen No. 2, while the rest is, in most cases, worn to extreme thinness.

The end F of the starboard boiler carried with it a complete ring of the metal to which it was riveted, the line of separation being at N, fig. 2. At this place the metal is about its original thickness and appears to be little worse than new. To account for this part giving way, while so much stronger than others, the rupture may be supposed to have been effected on the same principle as that by which the barrel, or breech, of a musket is burst when heavily charged with powder, and the wadding not rammed home. On this supposition a rapid and excessive accumulation of steam must have taken place, and the circumstance of the end F having exploded favours such a conclusion, for had the vapour been gradually evolved, the numerous weak parts of both boilers, one would suppose, would have first given way, or at any rate that the part T would alone have been blown off. The uncertainty respecting the quantity of water in the boilers might also be adduced; for as the engineer tried the gauge cocks the moment after blowing off steam, we know that the foaming of the water consequent on the latter operation would render all *immediate* appeals to the gauge cocks useless—at such a time water would have been given

out had the cocks been placed on the *top* of the boiler. But it is not necessary to seek for the cause of this explosion any further than in the state of the boilers; they are completely worn out. Had the end F not been blown out, and thereby counteracted to some extent the effect of the rupture at T, both boilers would probably have been hurled to some distance from the boat. It is singular that no person was *scalded* with the hot water; neither the engineer, who was standing at the gauge cocks, and was knocked to one side of the boat, nor the fireman, who was partly in front of F, fig. 1, and carried, he knew not how, to the stern of the boat, received any injury. Nor was there any signs of water in the direction which the moving masses took. The end F was shot into the Captain's office, driving the front before it, but no water had followed, since every thing appeared dry when I saw it taken out.

The pipe P of very strong wrought iron, was entirely laid open, and O O, separated from it. The steam and feed pipes, R and D D, were broken and carried away. At H, fig. 1, there was a long rupture in the middle of a sheet, but it had obviously been caused by the sharp edge of some heavy machinery falling on the place. At the edge of the first sheet on the end of the boiler L, fig. 2, and on a level with the water line, is a small triangular hole through the metal, which I have tried to represent at J. Each side of this hole does not exceed three-quarters of an inch, and so far from its having been produced by a blow, it bears every sign of the piece displaced having been *corroded away*. The edges present no signs of fracture, and they are as thin almost as the thinnest specimens sent. Other very thin places have been detected by hammering in the same region.

THOMAS EWBANK.

New York, May 5, 1841.

Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. FRANCŒUR. *Translated by* W. H. EMORY, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 374, VOL. I.]

[Translated for the Journal of the Franklin Institute.]

19. *The Compass.*—This instrument is formed of a box, in the centre of which, supported on a point, is a steel needle, *n s*, (fig. 28. pl. II) rendered magnetic. It is a well known property of the magnetic needle that it takes a direction called the magnetic meridian, which is constant nearly for the same locality, and which does not vary much from that of a line running north and south.

The magnetic needle is a blade of steel, A B, (fig. 27,) long, slender, and pointed at the two ends. It receives the magnetic property by rubbing it with a magnet from one end to the other and always in the same direction. A cap of brass, or what is better, a cap of agate, is fitted in the needle, near its centre of gravity, which is scooped out in the shape of a cone, the apex of which rests on a very fine point, upon which the needle traverses with scarcely any friction, and is left free to present its two ends to opposite points in space.

If the needle before being magnetized is horizontal, or balanced when placed on the point, it afterwards takes a direction very much inclined to the horizon, and is brought back to a horizontal position by placing a piece of wax on the end which is uppermost.* Thus the process of magnetizing causes the needle when freely suspended to take a fixed direction, oblique to the horizon, and in the plane of the magnetic meridian. The inclination being overcome by applying a weight, the needle is left free in the horizontal motion, and takes a direction which at Paris is north-westerly and differs from the true meridian 22°. This direction changes with time and place, but for our purposes it is sufficient that it remains the same for many days together, in each locality. The northern and southern ends of the needle are called respectively the north and south poles. They are marked N and S, or sometimes to distinguish the northern end of the needle it is rendered blue by heat.

The power which determines the horizontal and vertical motion of the needle, seems to be the force of attraction exercised by large masses of iron in the interior of the terrestial globe, which by the known power of the loadstone to attract iron, forces the needle to take positions in the direction in which this power is exerted.

20. The compass represented in fig. 28, is a smooth square box containing a circle plated with silver, which is divided into three hundred and sixty degrees, and into half degrees. In the centre, and perpendicular to the plate, is a pivot of tempered steel, upon the point of which a magnetized needle, *n s*, turns freely upon its cap, so that the two ends of the needle pass very near the graduated circle without touching it, and enable the observer to read the graduation to which the needle corresponds.

The box is of wood, or of copper; iron is carefully excluded from it; and even the observer must not carry a key or any other article of this metal about him, by which the needle will be made to deviate from the magnetic meridian. The box is fastened together by dovetailing, or by brass screws. A glass fitted over the circle and held

* Copper wire is generally used in the United States as the counter weight for needles of the surveyor's compass.

in place by an elastic strip of brass, shelters the needle and plate from wind, and is sufficiently near without touching the needle when the compass is horizontal, to prevent it from being thrown off the pivot.

The needles are usually six inches long, and are a little raised at the ends, to give the oscillations more stability, at the same time it takes nothing essentially from the freedom of motion. The pivot is perpendicular to the limb and the bottom of the box, in which it is placed exactly in the centre. The last condition is ascertained by turning the box 180°, and if fulfiled, the points of the needle traverse the same track over the graduated circle.

Upon one of the sides of the box (fig. 15) is an alidade A B, movable upon an axis; this alidade has a motion about the axis in a vertical plane when the compass is horizontal; it is formed of a small hollow quadrangular tube, fitted tight against the side of the box and closed at each end by a metallic plate. Each of these plates is pierced with a small hole, and has a verticle tongue above, which takes the place of the thread in the ordinary alidade. Looking at an object through one of these holes, the opposite tongue should appear to coincide with the object. It is necessary that the axis of the alidade should be exactly parallel to the diameter of the circle marked zero and 180°. An axis fitted to the middle of the alidade enables it to revolve in a plane perpendicular to the circle of the compass.

A ball and socket is fixed under the box (fig. 13) and attached to it by a wooden plate with three arms. The two spurs, *a* and *b*, and the small bolt *c*, enter into holes under the box, and fix the plate there by means of the bolt *c*. Thus the compass can be made to take the horizontal position *a b c*, and turn freely upon the axis *i*. A clamp-screw arrests the motion; and by the aid of a tangent screw, very delicate movements can be given. The instrument is leveled by means of spirit levels attached to the box, or by moving it until both ends of the needle, in an entire revolution of the box, escape contact with the glass cover and retain their position. This is an imperfect mode of leveling, but the degree of precision obtained by observations with this instrument does not require greater accuracy.

When the compass is not in use, the pivot is relieved from the weight of the needle, which is pressed against the glass, by the aid of small lever, *il*, (fig. 28) one end of which is seen out of the box, and the other end *i*, carrying a ring in contact with the needle.

21. To explain the manner of using the compass in the measurement of angles, it is sufficient to remark that in every position which the box takes in turning on its axis, the magnetic needle preserves a constant direction, (the oscillations of the needle having ceased) as if fixed in space. If the needle reads 20° and 60° in any two positions,

the box and alidade in passing from one to the other has evidently traversed 40°, the difference between 20° and 60°.

Thus, in observing on two distant objects, after the oscillations of the needle have ceased, read each time on the limb the degrees marked by the same end of the needle; the difference of the arcs, passed over by the sight, reckoning from the magnetic meridian, measures the angle of two visual rays drawn from the station to these objects, reduced to the horizon. It would appear, then, that the compass can be used in the same manner as the graphometer in measuring angles and in plotting. It is, however, much less accurate. To lay down a section of country represented by fig. 24, the process is the same as that described in article No. 18.*

The determination of angles by means of the compass is far from correct; for besides the radius of the limb being small, and seldom reading nearer than to a quarter of a degree, the distance is so great from the graduated arc to the point of the needle, which is easily moved, that it is difficult to ascertain with accuracy the point of coincidence, or in other words, the given angle. The compass is indeed a very imperfect instrument, and is never used when exactness is required; but the use of it is so simple and expeditious that it is generally resorted to in all cases not requiring great precision. After staking signals on the angles of the outline, we proceed by the method of making the circuit, which consists in chaining entirely around the polygon to be surveyed, and measuring all the angles. Place signals at the points A E D C B, (fig. 29;) from A, direct the instrument to E, and read the angle passed over by the instrument from its direction A B, and measure the distance A E; then from E, direct the instrument to D, read the angle measured, and chain the distance E D, and so on around the entire figure, (see No. 26.)

We thus have all the sides and all the angles of the polygon, from which it is easy to plot it on paper; if the work does not close, or in other words, if the last line B A does not fall so as to join E A at the point A, which is usually the case in surveys, made even with this imperfect instrument, we can judge of the extent of the error and make approximate corrections. If any object is remarked, when going round, desirable to be placed on the plot, its position is determined, without the necessity of approaching it, by the method of intersections (explained No. 18.*)

It is unnecessary, when the compass is used in running courses, that all the signals be seen at the same time; it is sufficient that one alone be visible; for this reason it is the most convenient instrument for

* See page 373, vol. I, 3rd series, on the use of the Graphometer, which should have been numbered 18.

laying down the courses of a river, the roads of a forest, &c. After placing signals at the principal bends A, B, C, D, &c., (fig. 30,) start at A and direct the instrument on B, then from B direct it on C, from C on the signal D, and so on; read each time the angle made with the magnetic meridian, and measure all the distances A B, B C, C D, &c. The portion of the polygon A B C D can then be constructed as heretofore.

It is not necessary, in the method of making the circuit, to make subtractions to determine the angles A B C, B C D, ... ; as the magnetic needle always takes a constant direction represented by the parallels, A N, B N, C N, ..., traced on the plan, and it is sufficient to construct with the protractor the angles N A B, N B C, N C D, ... which are the same in fact as those read from the compass.

The use of the protractor can be avoided by fixing the sheet of drawing paper, which is to receive the plot, firmly on the table, and placing the box on the paper and turning it until the needle takes the directions successively observed at the different stations. In these positions the box is made to take positions parallel to those at the stations, and the lines drawn with a pencil along the edge, which serves as a rule, are right lines parallel to the visual rays seen through the alidade. To facilitate this operation, the alidade, which is only fixed to the box by a screw which answers as an axis, is removed.

22. Some improvements have been made in the compass. A small telescope is used in place of the alidade, furnished with cross hairs at the focus of the object glass, as described in article 8. One of the hairs should be so placed as to describe a plane parallel to the principal diameter (zero and 180°.) On the outside of the tube, sights are attached. The telescope is used for objects at a great distance, (see fig. 28.)

A small graduated arc of copper is attached to the telescope by means of which the position of the telescope with relation to the horizon is given; so that besides the horizontal angle included between signals, the angular height may be obtained, that is to say, the angle made with the horizon by a visual ray to the signal, (No. 46.)

To place the instrument quickly in adjustment, the universal joint represented in fig. 13, is used; for slight movements, a tangent screw is fitted to the box.

23. *The Plane Table.*—This is another instrument used for projecting plans; it requires scarcely any knowledge of geometry, and is very easy to use. It consists principally of a small rectangular board, 22 by 30 inches on the sides, which can be fixed horizontally on a set of legs. A sheet of paper is stretched on the surface to receive a plot of the work as the successive observations are made. The plane table with its legs, can be carried from place to place, (see fig. 19.)

It is composed of a stand with three legs, surmounted by Cugnot's joint, (No. 13,) by which the table is made horizontal. A spirit level is attached to the table, to indicate if it is horizontal; this may be ascertained also by placing a billiard ball on the table, and if it is horizontal, the ball will remain in repose in any position it is placed.

As a sheet of paper 22 by 30 inches would not, in most cases, be large enough to receive the plot, and as it would be difficult to change the paper, a number of sheets are pasted together and rolled on two parallel cylinders placed under the side edges of the plane table, which are movable about their axes. Each cylinder, or roller, carries a cog wheel, with a click which prevents them turning but in one direction. When necessary to extend the operation of plotting farther, the click is disengaged, the paper unrolled from one of the cylinders and rolled on to the other. For this purpose a key is applied to the axis of the cylinder, which is made square and to project beyond the end. The paper is thus always kept stretched on the table, and is strengthened by being pasted on muslin or silk. To avoid confusion, the rollers are not represented in fig. 19.

The table P P is fastened by four clamp screws, *v v*, to another and smaller table, *p p*, which last is fastened solidly to the joint, and by means of the central axis E turns upon a horizontal disk, *c c*.*

P P, fig. 19, is the table which carries the plot stretched upon it; *p p* is the second table upon which the first is fixed by four screws, *v v*, at the angles; *c c* is the disk or circular plate fixed at the joint N. The pivot is a large bolt through the centre, the lower end of which terminates in a screw V, with a milled head; after passing through the disk this bolt passes between the lateral bars L L, of the joint. To clamp the table the screw is tightened.

In place of Cugnot's joint, the ball and socket (Figs. 13 and 22) which is lighter and less costly, can be used. There is the disadvantage, however, that it is more difficult to level with, and the table when leveled is disturbed by the slightest pressure.

It is frequently necessary to give a small motion of translation to the upper table; this is done by means of a tangent screw R, which is attached below *c c*. The starting point of the plot should be in a vertical line directly above the corresponding point on the ground. With the aid of a plumb line, or a pebble dropped from under the table, this position is soon obtained.

*The manner of connecting the plane table with the tripod has been much improved upon in the instruments of recent construction. The improvements consist chiefly in dispensing with the small table *p p;* the adaptation of screws for the purpose of leveling the table, and a contrivance by which the tangent screw can be thrown in or out of play.

24. There are three ways of using the plane table, which are combined together according to the nature of the cases which present themselves. The alidade represented in Figs. 10 and 18, is used for sighting. The end of the dividers, or a needle, is placed at the point on the table, which represents in the plot the place on the ground occupied by the instrument. When directed towards a signal to be projected on the plot, the edge of the alidade is placed against this needle, which serves as a pivot and point of support. A line drawn with a pencil along the edge of the alidade, will be the horizontal projection of the visual ray from the station to the signal.

Before explaining the three methods above referred to, we will explain the method of projecting a triangle, R S P, (Fig. 25.) Fix the plane table at R and level it, then direct the alidade to the points S and P, and draw in their respective directions, with a pencil, the indefinite right lines *rp*, *rs*. This done, remove the plane table to S, and measure the distance RS; then take from the scale which is adopted for the plot, the distance *rs*, equal to as many parts as there are units, &c. of measure in the distance RS, and the point *s* on the plot will correspond to the point S on the ground. Arrived at station S, place the plane table so that the line *sr*, already traced, shall be in the direction SR, and the point *s* on the paper be vertically over S. The alidade when placed on this line should have its sights directed on the signal R. From this position turn the alidade about the point *s*, until the third point P, is brought in the line of the sights. Draw the indefinite line *s p* P, and the point where it intersects *r p* is the projection of P. Thus *s p r* is the horizontal projection of S P R.

With the aid of a protractor and dividers, the dimensions of the angles S, R, P, and the length of the sides S P, R P can be deduced from the figure *spr;* from which we see that angles and distances which are inaccessible, can be measured by means of the plane table.

This being well understood, let us explain the three methods of plotting with this instrument.

25. The first is the *method of intersections*, explained page 373, vol. I. The base A E, (Fig. 24) is measured with a chain, and the plane table is established successively at the two extremities A, E.

A right line *a e*, is traced on the paper, equal in distance to A E when reduced to the scale of the drawing. When the plane table is placed at A, it must be leveled, and the point *a* placed immediately over it, as heretofore explained, and the line *ae* must be in the direction AE.

The alidade is then directed to the signals B, C, D . . . ., successively, by placing its edge againt the needle fixed at the point *a*, and turning the alidade around it. As the different positions are taken, the

lines *ab, ac, ad* . . . . ., corresponding with AB, AC, AD . . . . ., are drawn. Thus a series of lines is obtained diverging from *a*, upon the prolongation of which is found the plot of the signals B, C, D, &c.

The instrument is then removed to station E, and is adjusted horizontally so that the point *e* shall be exactly over it, and the line *ea* in the direction EA. This done the same operation performed at A is repeated at E, that is to say the line *ed, ec, eb,* &c. diverging from the point *e* are drawn, corresponding to the directions ED, EC, EB . . . . ., respectively. These lines intersect the first at the points *d, c, b,* &c., which are the representations on the plot of the signal D, C, B, &c. To avoid confusion and errors in the intersections, write along the lines drawn from A and E something to distinguish the particular signal each line corresponds with. After the lines are traced, angles and distances can be ascertained without actually measuring them.

26. The method of *making the circuit,* alluded to in Nos. 18 and 21, is longer but more exact. To plot the polygon (fig. 20) a station is made at every angle. Beginning at A, the plane table is established according to rules already given. The alidade is turned towards E and a line traced on the paper in that direction. The distance A E is measured and laid down on the line *ae* just drawn, by means of the scale, and the point *e* on the paper represents E on the ground. Then remove the instrument to E and adjust it by placing *e* over E, and the line *ea* upon EA; fixing the plane table in this position, move the alidade alone by turning it around *e*, and trace the indefinite line which coincides with E B. The distance EB is measured as before and laid down on the plot in the line *eb*. Thus we proceed from angle to angle until the whole circuit of the polygon is made. On getting back to the station A, the polygon closes exactly if the work is correct.

This method is the one usually practiced to take the contour of woods, the sinuosities of roads and streams, and whenever from any one of the stations but few of those adjacent can be seen.

27. The third process consists in establishing the plane table at only one station C, (fig. 26.) This station is generally chosen in the interior of the figure to be plotted, and at such a point that all the other signals can be seen from it. The alidade is directed successively in the directions CA, CB, CD . . . . ., and the lines C*a*, C*b*, C*d* . . . . . traced on the paper with a pencil. This done, all the distances CA, CB, CD . . . . ., are measured with the chain and put down on the paper by means of the scale, and the points *a, b, d,* analogous to A, B, D, are thus determined.

28. With the aid of a declinator, the time required in adjusting the plane table in reference to its bearings, is much abridged. The declinator is a small compass comprised in a long rectangular box, with

the needle having a play of about forty degrees. After the plane table is fixed at the first station as heretofore explained, place the declinator on the table and turn the box until the needle takes the position of zero, then draw a line along the side of the box. When the table is transferred to another station its proper position is given to it by placing the side of the box on this same line, and turning the table until the needle is on the zero point of the graduation. The table is then fixed in the position required for performing the necessary operations, and is the same, or nearly so, as that which would have been obtained by allining the instrument on the preceding station.

29. The explanation given above of the construction and use of some of the instruments used in topography, is sufficient to show the manner of tracing the plan of a city, district of country, park, forest, or any other locality not very extensive. There are many other instruments designed for the same purpose, but they are intended for special cases, and enough has been said to form an idea of the use of them.

Peculiarities sometimes present themselves in the field, which the preceding methods do not provide for, requiring the resolution of triangles to obtain the position of a signal on a plot. An explanation of the means then resorted to is the subject of the following chapter.

[TO BE CONTINUED.]

Description of a Plan for Curving Railroad Bars. By ALFRED C. JONES, Engineer.

TO THE COMMITTEE ON PUBLICATION.

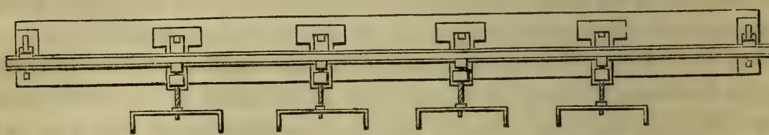
GENTLEMEN.—In connexion with the report on the New York and Erie Railroad, I hereby submit a plan for curving railroad bars; devised by me while engaged on that road.

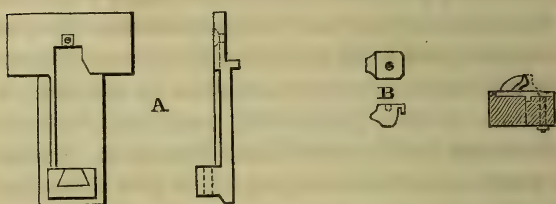
On all well made railroads, the bars should conform to the curves; this in most cases has been done by springing the bar, and spiking it to its place. This is an imperfect method, for in a short time the running of the cars, assisted by the tendency of the bars to return to a straight line, causes them to become chords, and thereby lessens the smoothness of running and increases the wear and tear. This being understood, I was directed by the engineer of the road to curve the bars previous to laying them.

The methods usually practised for that purpose I discarded, as being too slow in their operation for a due observance of economy; and having often experienced the good effects of the screw as applied to similar purposes, I devised the arrangement as figured. As it will be easily understood, a description of the individual parts is unneces-

sary further than to say that the heads are of cast-iron, (A, one enlarged) the screws of wrought iron, one and an eighth inch in diameter, and a number six thread, the end of the screw being reduced so as to enter a countersunk hole in the back of the follower B, to keep it steady.

The backing heads are seventeen feet six inches apart, and the four others placed at equal distances between them. All being bolted to a hemlock bench, seventeen feet six inches long, eighteen inches wide, and eight inches deep.





Mode of Operation.—The bar being placed with its base on the bench, the two end followers are slipped in, and their screws turned to a certain extent; the two middle ones are then run up and the bar forced to a greater distance; this releases the two end screws, which are unscrewed and the followers removed; the two middle ones are then released, and the bar marked on its inner side with a stroke of paint for each eighth of an inch (versed sine) of the curve, this also shows the concave side of the bar, and saves time in sorting for laying. The distance to which a bar is sprung in the machine is usually five inches, this gives a permanent set of about half an inch; the bars are marked with one eighth less than what they stand at, thus $\frac{1}{2}$ inch |||, meaning three eighths; this is to compensate for a partial straightening of the bar, and it is also better in laying, to decrease than increase the curve.

I will remark that the elasticity differing in bars, the distance to which they should be sprung will depend on the judgment of the operator, some requiring but two inches and others more than five, to retain a permanent set of half an inch.

This machine being in operation only during the most inclement part of the last winter; I am not prepared to say what is the maximum number of bars which can be curved in a day, but with active hands they may be curved as fast as brought to the machine; four hundred have

been curved in a day by two persons attending the screws. The T shape form of the castings is to admit of a larger surface for the outer web to be hammered on when bars are wanted to be adapted to a small curve for temporary tracks. Blocks of wood being interposed between the follower and the bar, it can be forced to any extent; this supercedes the necessity of having the screws made long, which would be an objection in the ordinary working of the machine. For the dimension and form of the bars see the report.

Ventilation of Subterranean Works, illustrated by practice at the Pawpaw Tunnel on the Chesapeake and Ohio Canal. By Ellwood Morris, Civil Engineer.

Ventilation, whether of buildings or mines, is usually a mere result of the laws of gravity, produced by a disturbance, either natural or artificial, in the equilibrium of the atmosphere at the spot ventilated; whereby a pneumatic current is formed which displaces the foul by fresh air.

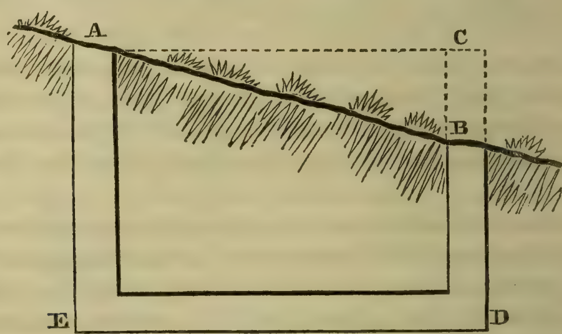
It is true that ventilating currents are sometimes produced by setting the air in motion with blowing machines; but this mode of ventilation is so rarely practised in subterraneous works that we do not propose to discuss it here; though we may observe that it is merely one of the means of disturbing the atmospheric balance, and bringing the gravitation of fluids into action to create ventilation.

The whole theory of the ventilation of mines is very beautifully and briefly laid down by professor Olmsted in his treatise upon Natural Philosophy, (see vol. ii.)

In the most general terms *ventilation* consists simply in *continually destroying the equilibrium of the atmosphere at the spot we desire to ventilate*, the attraction of gravitation being then brought into play, fresh air moves instantly to restore the disturbed balance, the pneumatic current which produces ventilation is promptly formed and all that we have to do is to arrange our means so as continually to destroy the equilibrium as fast as it is restored, and leave the rest to the operation of the fixed laws which govern the gravitation of fluids.

This result it is generally easy to attain by so planning our works as to bring to our aid some of the immutable laws of nature herself; thus in the case explained by Professor Olmsted, which, as we have before stated, comprises the *fundamental principle* of ventilating mines, though it admits of being acted on in numberless ways by varying our arrangements to suit the particular locality.—Let A E and B D be two shafts, sunk the same depth, E D, (we quote the substance from memory not having the book at hand,) it is manifest that until

joined by the drift E D, the air in both will remain quiescent; but suppose the drift E D to be completed, then during the *summer* the longer column of air A E, being cooled by the surrounding earth, would inevitably preponderate over the shorter column of cold air B D, because the density and of course the weight of the cool column A E, would be greater than that of the compound column of the same height C D, for the portion C B being formed of the summer atmosphere would be warmer and lighter than the air either in B D or A E, both of which would be cooled by the earth, consequently a current of air would continually descend A E, pass along the junction drift E D, and finally rise out of D B.



In the *winter* the reverse of this would take place, and the ventilating current would then descend B D, (for the compound column would at that season be heavier) and passing from D to E ascend E A; and this train of reasoning will hold good by inversion, even in those shafts of vast depths, where the heat of the earth's nucleus would enter as an important element into the disquisition.

Such is the simple principle which produces the perfect ventilation of the most complicated mine; it is only necessary that there should be a single, and but a single, continuous passage to conduct the air to every part of the mine, the beginning and the end of this passage must both be above the surface of the earth, they may be near together or far apart; they may even be at the same level, though the ventilation will be more brisk in proportion as their elevation differs, and though the continuous passage may curve or recurve in its course, no connexion must be opened from one part to another, unless by doors properly constructed to prolong or shorten the distance ventilated, as is often practised in extensive coal workings: in fact every mine must be regarded as one or more syphons inverted, any two communicating air shafts forming the legs of which the apertures are above ground, and we may curve or contort the intermediate part as

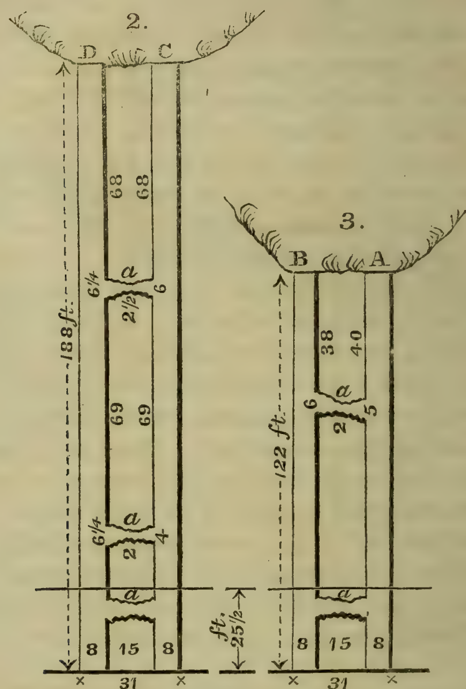
we please, it will in principle remain an inverted syphon still; all that is necessary then to ventilation, is to destroy the equilibrium of the air in this syphon, by diminishing its density in one of the legs, or increasing it in the other, when the pneumatic draught will instantly begin, and continue until the disturbing cause ceases to act.

In sinking the working shafts of the Chesapeake and Ohio Canal Tunnel, they were sunk in pairs, each being eight feet in diameter and fifteen feet clear apart; they were driven down side by side, so that whenever the air became foul in one, a draught hole could be cut to the other, and the inverted syphon being formed, ventilation, induced by the presence of disturbing causes, would promptly begin. It was no uncommon thing in sinking these shafts, for the air at the bottom to become so impure, that the miners would be compelled to stick two or three candles together, in order to procure the ordinary light of one; whenever such became permanently the case, draught holes were cut, and the inverted syphon completed. It would sometimes happen that even after the draught hole was driven through, the air would still so nearly balance in the two shafts as to produce a too sluggish ventilation, and require an artificial disturbing force; in such cases a small fire, built in the draught hole, would immediately accelerate it, and produce a brisk pneumatic current down the shaft furthest from the fire, and up that nearest to it. Thus to determine a flow of air down shaft C and up D, (see Fig. 2,) it was only necessary to kindle a fire in the draught hole close to D, when the air in shaft C, becoming heavier than that in D, (owing to the rarefaction produced by the fire in the latter,) would immediately preponderate, and cause a current to ensue, which would be more or less brisk in proportion to the activity of the fire, or the degree of disturbance of equilibrium produced.

It was only under occasional atmospheric peculiarities that the use of fire became necessary, for although the tops of each pair of shafts were upon the same level, disturbing forces of some sort were usually present; thus—a difference of the number, or animal heat, of the men working in each shaft—an unequal number of buckets of water, or soil, hoisted out—a greater frequency of blasts in one than the other—superior coolness produced by a greater evaporation from the dripping sides of one—and other causes, apparently insignificant, would almost always create a difference in the temperature, and of course in the density of the atmosphere within the respective shafts, sufficient to excite a ventilating circulation; indeed, though frequently down in the shafts, the writer never recollects descending without witnessing a perceptible current of air, which was sometimes quite strong without the presence of fire.

Fig. 2 exhibits a vertical section of shafts C and D, 188 feet deep, showing the number of draught holes *a*, it became necessary to cut preparatory to working the heading.

Fig. 3 exhibits similar information respecting shafts A and B, 122 feet deep.



All the shafts were sunk upon the centre line of the work, and being completed, the heading workings were commenced as soon as the water sumphs at the feet of the shafts were sunk and finished. These workings were prosecuted without any other means of ventilation becoming necessary than an occasional fire at the foot of the shaft. In very damp weather the gunpowder smoke would sometimes hang heavily in the workings, and produce the most intense darkness; but the atmosphere at the working breasts never became oppressive to the lungs.

The following vertical section (Fig. 4,) shows the length to which the above system of ventilation was carried in the tunnel referred to;

it presents the state of the workings, and the distance of the respective headings from the shafts or portals at the time the workings were united or driven out—immediately previous to which, the writer can state from personal inspection, that no unpleasant effect upon the organs of respiration was perceptible in any part of the headings, and consequently the limit of ventilation was not reached in these tunnel workings.

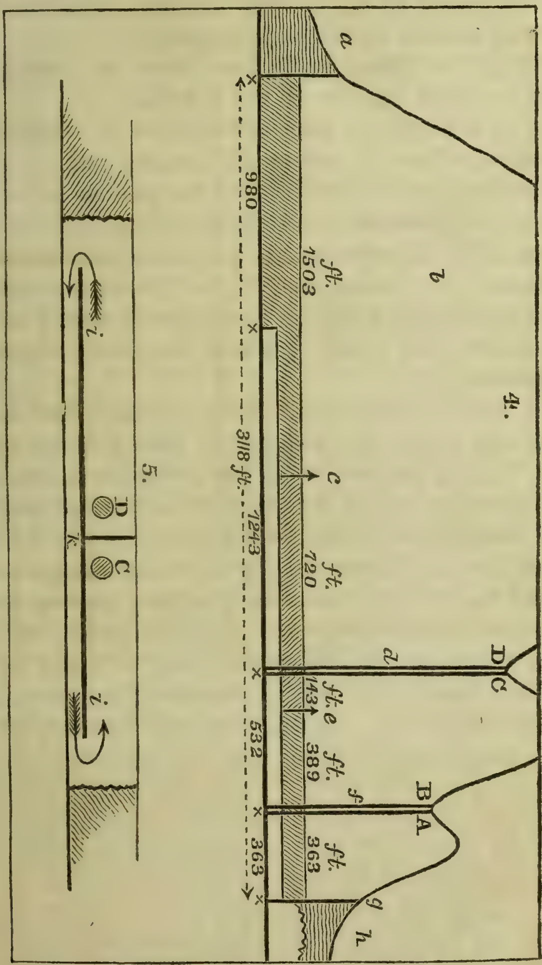


FIGURE 4.

a South Portal.
b Blue Slate Rock.
c Headings united June, 1840, at 340 feet under ground.
d Shafts 188 feet deep.
e Headings united June, 1839, at 230 feet under ground.
f Shafts 122 feet deep.
g Driven out April, 1839.
h North Portal.

FIGURE 5.

i i Air-tight Partition.
k Horizontal Section.

Indeed we entertain but little doubt that inasmuch as the material wrought engenders no deleterious gas, we might, by bringing fully into action, through the use of air-tight partitions, the principle of the inverted syphon, have proceeded safely with the heading at least a quarter of a mile from the feet of the working shafts.

Fig. 5 exhibits a plan of the partitioning which would have been put in had the air become foul in the workings, and by air-tight partitions upon this plan, or some other device operating upon the same principle, and perhaps also the use of a strong fire, as an auxiliary disturbing force, we repeat the conviction that we might have driven our heading from the shafts nearly, or quite, a quarter of a mile in each direction, which would enable working shafts in similar tunnels to be spaced at *half a mile asunder*, whilst intermediate air shafts would become entirely unnecessary.

Fig. 4 exhibits a vertical section of the tunnel and its shafts, with the points of junction of the headings.

Fig. 5. exhibits a plan of the mode of ventilation designed for the shaft workings, in case the air became foul.

Referring to Fig. 5, D being the wettest and coldest, was designed to be the downcast, and C the upcast shaft; the air descending D would pass in the direction of the arrows, around the partition, close to D's heading, and thence returning on the opposite side of it, pass close to C's heading, and turning again, finally ascend the shaft C. In heavy weather a fire would doubtless have been required at the foot of the upcast shaft.

It will be observed that from the south portal, the heading twelve feet and a half high, was driven 1503 feet inward, the bottoming at the time of junction being 980 feet in, or the tunnel for that distance presenting a section of twenty-five and a half feet altitude, by a width of twenty-seven feet; the atmosphere in the heading remained quite pure and easy to breathe, up to the last moment. Here it will be noticed that the only external disturbing force operating to produce ventilation, was the difference of level between the crown and floor of the tunnel, or twenty-five and a half feet; and yet this and incidental causes kept the air within constantly in motion, and in a state quite fit for respiration. In clear and cold weather, the atmosphere within the tunnel being warmer than that without, the cold air would force in along the floor of the work, and a brisk current, indicated by the floating powder smoke, would be visible, moving out along the roof. On the other hand, in damp and sultry weather, the air in the tunnel, cooled by the rocks, and the evaporation from the wet floor and dripping sides, would become colder than the external atmosphere, and then the smoke from the blasts would roll along the heading floor, and tumbling over the bottom breast like water, be seen flowing out of the tunnel close to the ground; thus indicating that at such times the fresh air was entering along the roof. Of course there were periods (though rarely,) when the atmosphere within and without would approach nearly to equilibrium, and on those occasions the air inside

would necessarily be rather close; but even then the frequent blasting, or even the variation of temperature caused by the motion of the sun, would quickly induce a relieving change, so that no complaint of impure air ever proceeded from the miners of the work; and there is strong reason to believe that in a tunnel of the dimensions of this one, by keeping the bottom breast close up with the heading, a distance of *half a mile* under ground might be driven from an open portal, without requiring any artifice to produce sufficient ventilation. Similar reasoning applies to the heading which was driven south 780 feet from shaft D, without any injurious or oppressive effect upon the lungs being noticed.

In both these cases, and in fact in the whole phenomena of ventilation, as witnessed in the perforation of this tunnel, we trace at once the operation of the simple principle with which we set out, namely, that we can always command a good ventilation whenever we possess the means of *continually destroying the equilibrium of the atmosphere at the spot to be ventilated.*

A perfect illustration of the observations of Professor Olmsted, upon a great scale, was noticed in our tunnel, after the shaft workings had been united together and driven out to the north portal, but before the juncture had been effected between the heading from shaft D, and that entering from the south portal. Throughout the *summer*, the column of air in shafts A and B being colder than the atmosphere at the north portal; and the column in shafts C and D, owing to their depth and increased wetness, being colder than either, a strong draught was found descending shafts A and B, and rushing out at the north portal—whilst a similar current was at the same time flowing down C and D, and from thence passing north to the feet of A and B, and there uniting with the currents of air from them both, would continually pass out at the north portal, bearing along with them the gunpowder smoke from the blasts, at times very briskly. This is precisely the result which Professor Olmsted's reasoning would lead us to expect. And again, during the *winter*, the ventilating currents were reversed, and the air then entering at the north end, was constantly found in a current moving south and ascending by all the shafts. This, too, is a result which was to be anticipated, because during cold weather the temperature of the external air being considerably lower than that of the tunnel and shafts, the outer column would necessarily preponderate, and the colder atmosphere forcing inward, would inevitably produce the southerly flow and ascending shaft currents, which were often noticed by the writer as actually existing during the season of cold.

We are perfectly aware that all we have above stated is as familiar

to the old miner as the flame of his candle; but we have nevertheless thought that there might be many of our readers who may have reflected as little upon this matter as was the case with the writer when his professional duties in connexion with the tunnel we have mentioned brought his mind to bear upon the subject.

Architecture.

On Chromatics as pertaining to Architecture. By Thomas U. Walter, *Architect.*

The importance of colour in producing architectural effect renders the subject of chromatics one of peculiar interest, not only to the architect, but to all who are in any way concerned in the construction of buildings. No matter how perfect and beautiful the forms and proportions of an object of taste may be, if the colours of the masses of which it is composed are glaring and inharmonious, the ideas it engenders will be precisely of the same cast; and, even supposing the taste of the spectator to be so well cultivated as to enable him to discern the beauties of its form through the distorting mask of discordant colouring, it will still fail to awaken agreeable emotions of taste.

The art of combining and arranging colours with reference to their operation on the mind, is regulated by laws which depend as decidedly on natural principles as those which govern the composition of sounds in music; and although there may be an endless variety of tastes, both in regard to individual hues, and to styles of composition, it is nevertheless true that any violation of the laws on which the harmony of colouring is founded cannot fail to produce an effect as disagreeable to the eye, as that which a deviation from the laws of harmony in music occasions to the ear; a knowledge of these laws is therefore indispensable to the production of beauty in architecture.

We frequently, however, find individuals totally unacquainted with the laws of harmonious colouring, who, nevertheless, possess a natural taste by which they are unconsciously led, in the arrangment of colours to the most pleasing results; but this taste is like what is termed "a good ear for music" unimproved by a knowledge of the science. We often hear both vocal and instrumental performances by persons who have no knowledge whatever of the laws of harmony; and even admitting such music to be agreeable, which is certainly not always the case, it would not be the less so if the performers understood their art. The same observations hold good in regard to colour. If an individual possesses a natural taste for the harmonious arrangement

of colours, that taste will undoubtedly be confirmed, strengthened, and purified by a knowledge of the natural laws on which chromatics are founded.

All the colours to be found in nature are embraced in three genera, denominated *primary*, *secondary*, and *tertiary*.

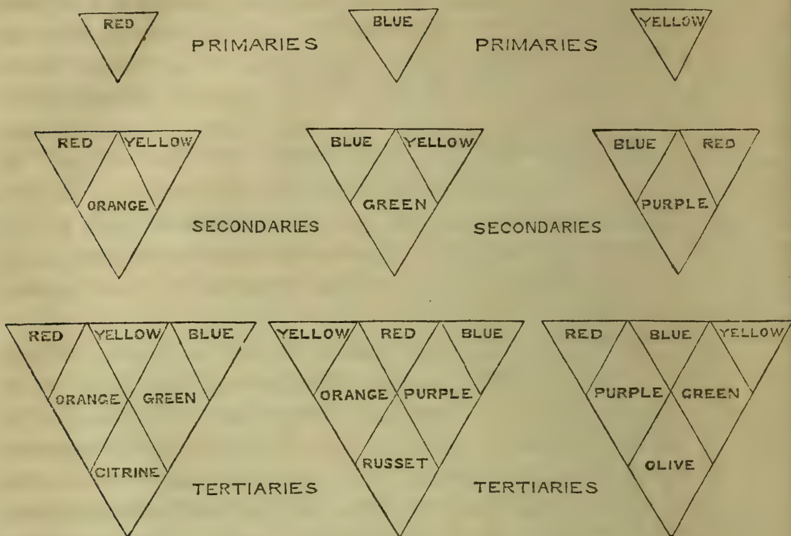
The *primary* colours consist of *red*, *blue*, and *yellow;* and of these three, every other colour is compounded, while they themselves are incapable of being produced by the composition of any colours whatever. Sir Isaac Newton has included in the primary colours all the hues which appear on the prismatic spectrum; adding to the *red*, *blue*, and *yellow*, the *violet*, the *green*, the *indigo*, and the *orange*. Sir David Brewster, on the other hand, by a different method of analyzing the prismatic spectrum, infers that it is composed only of red, blue, and yellow—and whatever may be the final judgment of opticians on this point, these are unquestionably the only primary colours of the artist.

Leonardo da Vinci, in his essay on the beauty of colour, reduces the number of the primaries to *two*, affirming that blue is not a primative colour because it is composed of light and darkness, as the azure of the sky, which, he remarks, is produced by the transparent body of the air illumined by the sun, and interposed between the darkness of the expanse above; but this explanation is destitute even of plausibility. There can be no doubt that blue is the true colour of the air itself, which it exhibits, notwithstanding its transparency, when seen in large masses. Indeed it must be obvious that if blue is any colour at all, it is most certainly a primitive, as neither of the other colours enter in any degree whatever into its composition.

The *secondary* colours are such only as can be resolved into two primaries; they also consist of three, one of which is *orange*, or a composition of red and yellow; another *green*, or a mixture of blue and yellow; and the third *purple*, or a compound of blue and red.

The *tertiary* colours are those which admit of being compounded of, or resolved into, two secondaries, or the three primaries; they consist of *citrine*, *russet*, and *olive*. Citrine is a compound of green and orange, or of the three primaries with yellow predominating—that colour having entered into the composition both of the green and the orange. Russet consists of purple and orange, or the three primaries with red predominating—for the same reason. And olive is composed of purple and green, or the three primaries with a predominating blue.

These remarks will be exemplified by referring to the following diagram, on which the primaries red, blue, and yellow are first represented singly; secondly, in their binary combinations producing orange, green, and purple; and thirdly, in their triple combinations producing citrine, rutset, and olive.



These three genera comprehend all the colours which are positive or definite, and the three colours of each genus, variously compounded, so that neither predominates to the eye, constitute the *neutral* colours, of which white is the most perfect example, being constituted of a combination of all the primitive colours. When, for example, the rays of white light which proceed from the sun are refracted by means of a prism of glass, or by drops of rain, as in the rainbow, they assume all the colours to be found in nature; hence, as the mere interposition of a piece of white glass between the sun and the object upon which it may be shining, cannot by any means impart colour to its rays, the beautiful hues we see can be nothing more than inherent portions of white light.

In view of these considerations, it is obvious that *red*, *blue*, and *yellow*, are the foundation of chromatics. These colours are, however, too intense to be employed in their natural and uncompounded state, especially in large masses, as their glaring contrasts are always unpleasant to the eye, and are certain to destroy the beauty of any composition in which they are freely used.

No better example can be referred to in illustration of the disagree-ble effects arising from broad surfaces of primative colours than the ed brick fronts of some of our city houses. This crude and fiery olour presents itself in every street, in painful dissonance, with all he tints and hues to which it stands related, and as the consequence, roduces an effect exceedingly repulsive to every one whose taste has een trained to a perception of the beautiful. So completely has cus-om triumphed over the taste of many of our citizens, that even the eddest of red bricks are not yet red enough for them, and we often bserve them painting their houses still redder; and then to heighten he incongruity, the joints are carefully pencilled the most glaring vhite. This is the very worst adaptation that could possibly be con-eived of the most unsuitable of all colours for architectural effect. f all brick houses were painted some agreeable *neutral* colours, the ppearance of our cities would be improved beyond calculation.

"From the positive nature of *red*," says an excellent writer on hromatics, "there is no colour requires more toning and managing, vhen exhibited in large masses;" and yet, in American cities, no col-ur is so lavishly and recklessly used as this. It should also be re-narked, that if either of the other primaries were employed in a simi-ar manner, the result would likewise be unpleasant. An agreeable rchitectural effect can never, under any circumstances, be produced vhere intense colours are freely used.

Burke, speaking of the effect of colour on the mind, observes that "those which seem most appropriate to beauty are the milder of every ort;" and Mr. Lush, in an essay on beauty in architecture says, "na-ure teaches us that all vivid and intense colours should be used with a sparing hand;" while Blair affirms that "colours chosen for beauty are generally delicate rather than glaring."

It should further be observed that even in the application of the intermediate hues, the strictest regard should be had to their arrange-ment, as without suitable contrasts balanced by concord and harmony, any composition will appear monotonous. Mr. Field says, in his Analogical Philosophy: "We acknowledge the power of colours to sooth and delight by gradation of hue and shade, to excite and ani-mate by various contrasts, and to distract and repel by infraction and discordance." And again: "The eye is quiet and the mind tranquil and complacent, when colours are opposed to each other in equivalent proportions chromatically, or in such proportions as neutralize their individual activity."

Our own experience teaches us that in order to allow the mind to pass with pleasure and facility from one image to another—from the impression of one object to that of another—the various effects must

be so harmonized as to leave no glaring object in the composition to arrest the attention, or start an unconnected thought. When, therefore, we seek to achieve effect by violent contrasts in colour, it is evident that the very opposite of beauty must be the certain result.

If, then, the beauty of an architectural object depends upon the harmonious colouring of the masses of which it is composed, it is evident that the same harmony must prevail in all the decorations and furniture of the building, or the composition will fail to be agreeable, even though its architecture be faultless. Hence, no one object in an apartment ought to be allowed to monopolize attraction; but everything should be so toned and balanced in its individual effect, as neither to interfere with the idea of a unity of design, nor tend to monotony.

These obvious deductions from the laws of harmony seem as yet to have been but seldom thought of. Apartments are usually painted without reference to any particular key of colour, and without the slightest regard to the furniture intended for their embellishment—in the choice of which either novelty, or its opposite extreme, the fashion of the day, is too often allowed to usurp the place of taste and reason; thus the most incongruous mixtures are frequently produced, and the effect of apartments which are beautiful in themselves wholly destroyed by the introduction of discordant colours, as well as by inharmonious forms.

Mr. Hays observes, in his excellent treatise on the laws of harmonious colouring, (p. 25,) that "the tone or key of colour is thefirst point to be fixed, and its degree of warmth or coldness will be regulated by the use, situation, and light of the apartment. The next point (he remarks) is the style of colouring, whether gay, sombre, or otherwise; this is more particularly regulated by the use of the apartment, and the sentiments which it ought to inspire; for as Sir Joshua Reynolds says, 'what may heighten the elegant may degrade the sublime.'

The tone or key of colour for an apartment should be fixed by the choice of the furniture, as that may be considered in regard to colouring in the same light as the principal figures in a picture. The general tone of the room must, therefore, depend in some degree on the colours of which the furniture is composed; if, for instance, the prevailing colour be blue, grey, cool-green, or lilac, the general tone must be cool; but if, on the other hand, it should be red, orange, brown, yellow, or a warm tint of green, the tone must be warm." It should, however, be observed, that these remarks relate only to the prevailing tints, as well managed contrasts are as necessary to the beauty of an apartment as they are to the beauty of a picture.

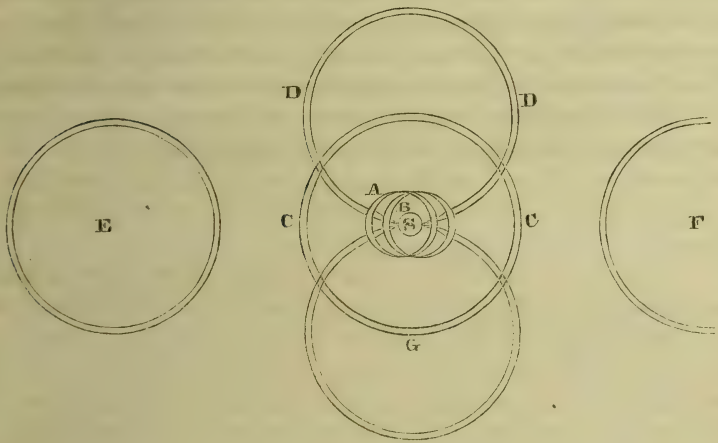
It may, perhaps, be objected, that by thus reducing taste to rule, we circumscribe genius. This might indeed be true of those who,

from a want of ability, use rules without a comprehension of their rationale; but rules are founded on reason, and so far from any fetters being imposed on genius by reason, genius itself is the highest possible grade of reason, in a latent state, operating, as it were, unconsciously by natural rules.

Physical Science.

An account of some Parhelia observed at Milford and Camden, Delaware, March 14th, 1841. By A. D. CHALONER, *A. M., M. D., Recording Secretary of the Academy of Natural Sciences of Philadelphia, &c. &c.*

Figure 1.* NORTH.



SOUTH.

The following is the account of the parhelia as seen at Camden, seventeen miles northwest of Milford. The day before (13th inst.) was clear, but some two or three days previous there had been some heavy rain. The morning of the 14th inst. the sun rose with unusual brightness with a clear sky; at 8 o'clock, A. M., the sky appeared to grow ropy, with uneven crossings in all directions, which first attracted attention. At 8½ o'clock the sun was surrounded with a circle, which then became of a dim appearance and of a *white* color; at 9 o'clock two circles, A B, appeared, with a *halo* around the sun, as represented by the letter S, fig. 1. A similar circle, G, was formed in the south, and in about ten minutes was completed, and at the same time the circles C, D, and E, appeared in like manner. At 9½ o'clock

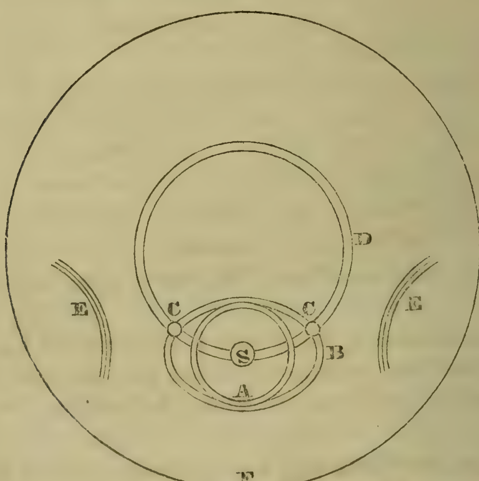
* For this description and drawing I am indebted to the kindness of A. Jackson, Esq., of Camden, Delaware, through Mr Thomas Oliver, of Philadelphia.

the circle F appeared in like manner; the color of all the circles was of a *sky red*, with the outer edge more of the tint of a rainbow; in *ten minutes* more, they were of their brightest colors; at 9 o'clock the circles were all full. The circle F never appeared to be a *fair* circle; the altitude of the circles A and B gave an angle of 29°, though somewhat oval, caused by the shadow over them. The circles G, C, and D, cutting the sun's centre, gave each an angle of 69°. The circle E, from its nearest point to the sun, gave an angle of 75°, while F gave an angle of 32°; these circles stood due east and west from the sun, G and D due north and south.

At 10 o'clock the circles disappeared gradually, and at 10½ o'clock they had vanished as they came on; at 12 o'clock there remained one circle around the sun, which continued until the evening. The next day the sky was hazy, and a storm of rain, hail and snow came on which lasted three days, with a strong north-east wind. The wind on the morning of the 14th inst. was light south-west, at 10 o'clock it shifted to the north-east, and in the afternoon it was strong north-east.

At Milford, Delaware, the appearance of the sun was somewhat different, as is evident from the following description.

Figure 2.*



Imagine a brilliant white circle, D, fig. 2, having the zenith for its centre, and passing through the body of the sun, then a beautiful double iris, A and B, (in figure resembling the telescopic appearance of Saturn and his ring,) encircling the sun, S. Then two parhelia, C C, at the intersections of the circles, in splendor rivaling the great

* This account and drawing is by David Straughn, Esq., of Milford, Delaware.

luminary himself; then parts of two great circles, E E, of a rainbow color, pointing to the horizon, F, and you have an idea, and only an idea, of the transcendent scenery of the heavens, at once beautiful and sublime, equally calculated to excite the fears of the ignorant, who view it as an omen of disaster, and the admiration of the intelligent, who regard it as the result of the laws of nature. This phenomenon was first observed at 9½ o'clock A. M., and continued until 10 o'clock A. M. The sky was free from clouds, but the atmosphere was hazy, the weather was mild and calm. It was not seen more than fifty miles distant from Milford; it was preceded by a shower from the north-west which cleared up with a brilliant sunset. On the 17th inst. an unusually severe snow storm for the season took place.

Another observer at Milford, Delaware, remarks that the sky was hazy on the 14th of March, at 10 o'clock A. M., without any appearance of clouds, the sun was of a whitish color and pale; so pale or dim that the shadow of an object that intervened could barely be seen. There were two circles around the sun, and in the first circle were *four parhelia*, colored with all the colors of the rainbow.*

The parhelia appeared to be east and west, north and south in the first circle, at the westerly one there was an arch in the form of a rainbow extending to the north-west, but of a yellowish white color. For an explanation of this phenomenon the reader may consult Brewster's Optics, page 227–260.

On examining the monthly meteorological reports for March, 1841, made to the Franklin Institute, from the different counties of Pennsylvania, I find that from the 14th to 17th of March there was an unusual prevalence of *stormy weather*, rain and snow of great depth, but at Silver Lake, Pennsylvania, vice versa, being dry, fine and clear; a similar state of weather being observed on the 14th inst. at Milford and Camden, Delaware, where the above appearances were observed.

At Little Creek landing, Kent county, Delaware, about three miles east of Dover and two miles from Delaware Bay, on March 15th,† 1841, the following appearances were observed by Mr. Charles P. Hayes.

"There was, in the first place, a very large circle around the sun which was intersected by two others whose tangents were the centre of the sun, each having a central bright spot, resembling the sun shin-

* I am indebted to Mr. Thomas Oliver, of Philadelphia, for his kindness in procuring information for me upon this subject.

† There is *probably* a mistake in this date (15th inst.) as the *parhelia* were observed at Milford and Camden, Delaware, at the same time, March 14th; all other accounts coincide as to the time.

ing through a thin cloud. But one of the most striking points in the scene was a beautiful rainbow *immediately under the sun,* which at this time shone bright and warm, the sky being almost clear.

On Wednesday afternoon, the 17th inst., a heavy snow storm took place.

Remarks relating to the Tornado which visited New Brunswick, in the State of New Jersey, June 19, 1835, *with a Plan and Schedule of the Prostrations observed on a section of its track. By* W. C. Redfield, Esq.

Communicated by the Author.

In a paper printed in the American Journal of Science, in which I referred to the support given by Prof. Bache to Mr. Espy's theory of storms, at the meeting of the British Association in 1838, founded upon observations made on the New Brunswick tornado, I have stated, that in my own examinations I had observed numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the whirling vortex at the surface of the ground; and further, that the direction of rotation was *towards the left*, as in the North Atlantic hurricanes.* It was due to Professor Bache that my observations should be brought forward; a task which has been too long delayed, partly from a desire that he would revise his former conclusions. The facts now presented form part of the evidence to which I then alluded.

If the effects which I present for consideration be due to "a moving column of rarefied air without any whirling motion at or near the surface of the ground," as maintained by Professor Bache,† we might expect to find a relative uniformity in these effects on the two opposite sides or margins of the track. How far this is the case may be seen by inspecting the observations which are found upon the annexed plan of prostrations.

The occurrence of these tornadoes appears to have been noticed from the earliest antiquity; and their violence has been considered as the effect of an active whirling motion in the body of the tornado; this peculiarity of action having often been supported by the testimony of eye-witnesses.

The whirling motion, however, has not been recognized by Prof. Bache, Mr. Espy,‡ or Prof. Walter R. Johnson,|| in their several

* American Journal of Science, October, 1838, vol. xxxv, pp. 206, 207.

† Transactions of the American Philosophical Society, vol. v, p. 417, New Series.

‡ Transactions of the American Philosophical Society, vol. v, New Series.

|| Journal of the Academy of Natural Sciences of Philadelphia, vol. vii, part ii.

accounts of the New Brunswick tornado; these writers having been led to adopt or favour a theory of ascending columns in the atmosphere, founded on the supposed influence of calorific expansion accompanying the condensation of vapor.

It is remarkable that previous to this period the evidences of the rotation, or other characteristic action, of tornadoes appear not to have been duly examined and recorded, nor even to have received the distinct consideration of scientific observers. We are therefore left to seek out the peculiarities of their action, by examining the direction of the prostrations and other effects of the wind; and from a careful induction from the effects which are thus registered as by the finger of the tornado, we may hope to arrive at satisfactory conclusions.

If the numerous prostrations of trees and other objects, which may be observed in the path of a tornado, be the effects of a violent whirlwind, it appears most reasonable to infer that this whirl had the common properties which may be observed in all narrow and violent vortices, viz: *a spirally descending and involuted motion* of the exterior and lower portions of the vortex, rapidly quickened in its gyrations as it approaches toward the centre or axis of the whirl, and thence continued (in the case of the whirlwind) spirally upward, but gradually expanding in its spiral course by an evolute motion in ascending towards the extreme height of the revolving mass.

If we now contemplate the action of this whirling body, while in a state of rapid progression, on the several objects found in distinct portions of its path, we may expect to witness effects of much complexity, particularly as regards direction; and, also, that amid this apparent complexity, some clue may be obtained that will serve to indicate or establish the true character of its action. Some of the effects which may be expected, or observed, will be here considered.

1. We may expect to find, in the path of the whirlwind, strong evidence of the inward or vorticular course of the wind at the earth's surface; the violence of which inward motion is clearly indicated by the force with which various objects, often of much weight, are carried spirally upward about the axis of the revolving body.

Now the effects of this inward vorticular motion at the surface of the ground, are clearly manifested in the cases before us; and are also well illustrated by Prof. Bache, in his paper on this tornado, although referred by him to a different action.*

2. As the effects which may be observed at various points in the track were produced at different moments of time, and by forces acting in different directions, as well as of various intensities, we may expect to find great diversities in the several directions of the fallen trees and other prostrated bodies; and further, as all the forces, in

* Transactions of the American Philosophical Society, vol. v.

addition to their inward tendency, have likewise a common tendency in the direction pursued by the tornado, we may expect to find, also, full evidence of this progressive force in the direction of the fallen bodies.

These effects, I need hardly state, are distinctly observed in the case before us; and appear likewise from the observations of Professor Bache. The results already noticed have been observed also in the tracks of other tornadoes: so that a general inclination, both inward and onward, amid the various and confused directions of the fallen bodies, is distinctly recognized by all parties to this inquiry.

3. It has been often noticed, that where two fallen trees are found lying across each other, the uppermost or last fallen points most nearly to the course pursued by the tornado.

In view of the facts above stated, much pains have been taken to establish, by induction, a central and non-whirling course in the wind of the tornado; first inward and then upward, like that resulting from a common fire in the open air. I do not propose to notice the insuperable difficulties which appear to attend this hypothesis. It is important to state, however, that all the above mentioned effects, when theoretically considered, are, at least, equally consistent with the involute whirling action of an advancing vortex. This important consideration I have not seen recognized by the advocates of the non-whirling theory; and it seems proper, therefore, to point out, as we proceed, other and more distinguishing effects of the whirling action.

4. It has been noticed, also, that the directions given to broken limbs and other bodies, by the successive changes in the direction of the wind as the tornado passed over, have been found in opposite courses of change, on the two opposite sides of the track.

This fact, too, has been strongly urged as disproving a rotary motion. But, unfortunately for the objection, this effect accords fully with the rotary action of a progressive mass of atmosphere; as is well known to all who clearly understand the *theory* of rotary storms.

In all such whirling masses the successive changes in the direction of the wind *result solely from their progressive motion*, and necessarily take place in opposite directions or courses of change on the two opposite sides of the advancing axis. This indication fails, therefore, as a theoretic test; and I now proceed to notice others, which are peculiar to a progressive whirling action.

5. In considering further the effects of such action, we may expect to find that the greatly increased activity of gyration which is always observed near the centre of a vortex, will be indicated by a more violent and irregular action in and near the path pursued by the axis of the whirlwind, than is found under its more outward portions.

This effect is often strikingly exhibited in the path of tornadoes; while, in the supposed ascent of a non-whirling column, it would seem that no part of the surface would be so much exempted from its action, and particularly from its power of prostration, as that lying near its centre.

6. As the effect of rotation must be to produce, on one side of the advancing axis, a reverse motion which is contrary to the course of the tornado, it is evident that on this side the prostrating power will be much lessened; that the cases of prostration, therefore, will be here less numerous; and that some of these, at least, will be produced in a backward direction, more or less opposite to the course of the tornado. By this criterion, not only the whirling movement, but the direction of the rotation also, may be clearly ascertained.

This effect is best observed by comparing the two opposite margins of the track, and is strongly exemplified in the case before us. Here we find, that most of the trees prostrated within five chains (110 yards,) from the northern or left-hand margin of the track, lie in directions which are more or less backward from the course of the tornado. The prostrations in this part of the track are also for the most part less general than on the opposite side of the axis,* a greater portion of the trees being left standing.

It sometimes happens, owing perhaps to the inward or involute motion having exceeded the progressive motion at a particular point, that some inclination backward will be found in the prostrations on the progressive side of the whirl, as seen on the sketch, Nos. 77 to 80. But these unfrequent cases by no means compare with the numerous backward and sometimes *outward* prostrations, found on the reverse side of the whirl, as illustrated by Nos. 1, 3, 4, 7, 9, 10, 12, 13, &c. on the left side of the track. Thus we find here a satisfactory indication that this tornado was a whirlwind; and that the course of its rotation was to the *left* in front.

7. It is also apparent, that the prostrating power of a whirlwind on the side of its reversed motion as just considered, will be limited to a shorter distance than on the opposite or progressive side of its axis.

This is seen in the more limited *extent* of the prostrations on the north or left margin of the track, as compared with the extent of those which incline inward on the right side of the apparent axis. There were many trees standing beyond the northern border of the track, but none had fallen.

* There was a vacant space in the belt of wood, immediately to the right of the line *c c*, or axis of the tornado, owing to which the effect mentioned does not appear so obvious in the figure.

SCHEDULE OF THE PROSTRATIONS

Observed on a Section of the Track of the New-Brunswick Tornado, of June 19th, 1835.

No.	Direction of Prostration.	Inclination.
	TABLE I. Left side of the track to the line *b b*—5 chains.	Inward and backward.
a	Tree lies S. 20° W. . .	110°
b	.. .. S. 80 W. . .	170
1	.. .. N. 67 W. . .	203
2	.. .. S.	90
3	.. .. W.	180
4	.. .. S. 80 W. . .	170
5	.. .. S. 40 W. . .	130
6	.. .. S. 40 W. . .	130
7	.. .. S. 80 W. . .	170
8	.. .. S. 10 E. . .	80
9	.. .. S. 50 W. . .	140
10	.. .. S. 50 W. . .	140
11	.. .. S. 26 W. . .	116
12	.. .. S. 50 W. . .	140
13	.. .. S. 65 W. . .	155
14	.. .. South . . .	90
	Mean direction, 16 cases, S.48°W. Mean inclination from course, inward and backward, 138 degrees.	
	TABLE II. Left side of the axis, from the line *b b* to *c c*—1½ chains.	
15	Tree lies S. 2° E. . .	88
16	.. .. S. 12 W. . .	102
17	.. .. S. 35 E. . .	55
18	.. .. S. 62 E. . .	28
19	.. .. S. 25 E. . .	65
20	.. .. N. 80 W. . .	190
23	.. .. S. 20 E. . .	70
24	.. .. S. 80 E. . .	10
25	.. .. S. 45 E. . .	45
26	.. .. S. 10 E. . .	80
27	.. .. S. 45 E. . .	45
28	.. .. S. 20 E. . .	70
29	.. .. S. 60 E. . .	30
30	.. .. S 60 E. . .	30
31	.. .. East. . . .	00
32	.. .. S. 75 E. . .	15
33	.. .. S. 56 E. [Included as belonging by its inclination to this table.]	34
35	.. .. East . . .	00
	Mean direction, 18 cases, S. 37° E. Mean inclination inward, 53 deg.	
	TABLE III. Right side of apparent axis from line *c c* to W E—3 chains.	
21	Tree lies N. 56° E. . .	34
22	.. .. N. 60 E. . .	30
34	.. .. N. 80 E. [Included as belonging by its inclination to this table.]	10
36	.. .. N. 85 E. . .	5
37	.. .. East (two) . .	0
..	.. .. East . . .	0
38	.. .. East . . .	0
39	.. .. N. 30 E. . .	60
40	.. .. N. 70 E. . .	20
41	.. .. N. 55 E. . .	35
42	.. .. N. 50 E. . .	40
43	.. .. N. 78 E. . .	12
44	.. .. N. 45 E. . .	45
45	.. .. N. 45 E. . .	45
46	.. .. N. 25 E. . .	65
47	.. .. N. 35 E. . .	55
48	.. .. N. 40 E. . .	50
	Mean direction, 17 cases, N.60° E. Mean inclination inward, 30 deg.	

No.	Direction of Prostration.	Inclination.
	TABLE IV. Right side of axis, from line W E to line *a a*—4½ chains.	Inward and backward.
49	Tree lies N. 67° E. . .	23°
50	.. .. N. 45 E. . .	45
51	.. .. N. 22 E. . .	68
52	.. .. N. 3 E. . .	87
53	.. .. N. 30 E. . .	60
54	.. .. N. 10 E. . .	80
55	.. .. N. 35 E. . .	55
56	.. .. North . . .	90
57	.. .. N. 10 E. . .	80
58	.. .. N. 3 E. . .	87
59	.. .. N. 45 E. . .	45
60	.. .. N. 10 E. . .	80
61	.. .. N. 35 E. . .	55
62	.. .. N. 60 E. . .	30
64	.. .. N. 40 E. . .	50
65	.. .. N. 20 E. . .	70
66	.. .. N. 10 E. . .	80
67	.. .. N. 20 E. . .	70
68	.. .. N. 40 E. . .	50
69	.. .. N. 70 E. . .	20
70	.. .. N. 50 E. . .	40
71	.. .. N. 35 E. . .	55
72	.. .. N. 30 E. . .	60
73	.. .. N. 50 E. . .	40
74	.. .. North (two) .	90
75	.. .. North " .	90
76	.. .. North " .	90
77	.. .. N. 20 W. (clump of 3)	110
78	.. .. N. 35 W. . .	125
79	.. .. N. 30 W. . .	120
80	.. .. N. 10 W. . .	100
81	.. .. N. 65 E. . .	25
82	.. .. N. 70 E. . .	20
	Mean direction, 33 cases, N. 24° E. Mean inclination, 66 degrees.	
	TABLE V. Right side of track, from line *a a* to outward limit of prostration—5 ch.	
63	Tree lies N. 65° E. . .	25
83	.. .. N. 45 E. . .	45
84	.. .. N. 40 E. . .	50
e	.. .. N. 55 E. . .	35
85	.. .. N. 70 E. . .	20
86	.. .. N. 23 E. . .	67
87	.. .. N. 31 E. . .	59
88	.. .. N. 20 E. . .	70
89	.. .. N. 22 E. . .	68
90	.. .. N. 10 E. . .	80
91	.. .. N. 55 E. . .	35
92	.. .. N. 70 E. . .	20
93	.. .. N. 55 E. . .	35
94	.. .. N. 68 E. . .	22
95	.. .. N. 25 E. . .	65

Mean direction, 15 cases, N. 44° E. Mean inclination inward from course of tornado, 46°.

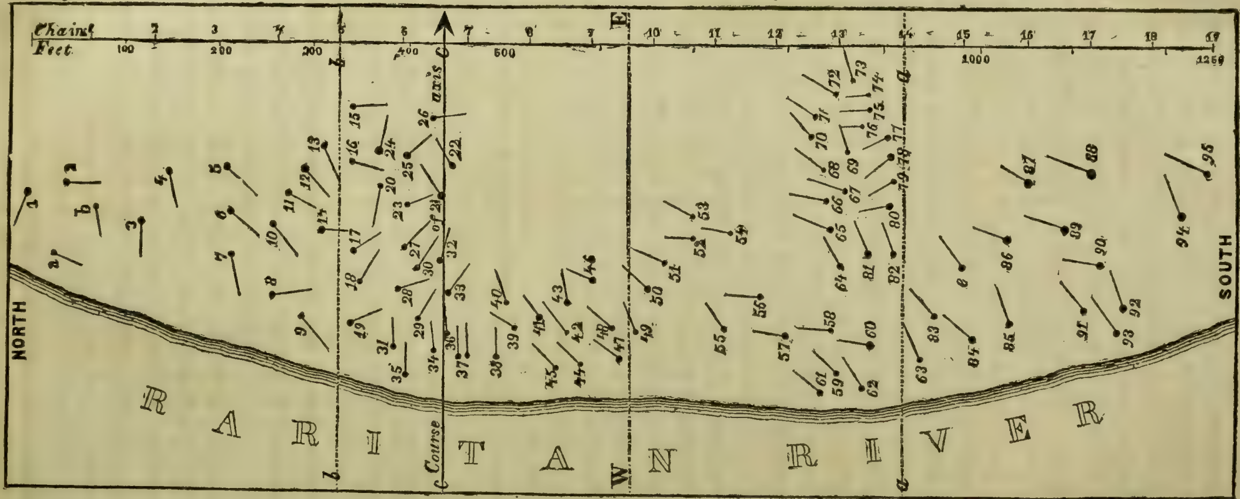
Mean direction of all the prostrations on *left* of axis, 34 cases, S. 3° W.—being 3° backward, or 93° inward and backward.

Mean direction on *right* of axis, 65 cases N. 38° E.—being 52° inward from course.

Difference of mean inclination on the two sides, 41 degrees.

Difference of opposite marginal sections (Tables I and V) 92 degrees.

NEW-BRUNSWICK TORNADO. (Plate I.)



Sketch of the Prostrations found on a section of the Track of the Tornado of June 19, 1835, *on the bank of the Raritan, opposite the City of New Brunswick, in the State of New-Jersey.*

Explanations.—The east bank of the river is here covered with a belt of wood; the latter having a very irregular outline on the east, where it is bounded by a clear field. The line *c c* represents the apparent course of the axis of the tornado: W. west, E. east. The large dots on the several figures show the root ends of the trees, which were chiefly a species of cedar. In all these cases of prostration, part of the roots were still fast in the ground. Course of the tornado east. The approximate positions of the several trees are in many cases slightly changed in the sketch, for the purpose of a distinct exhibition of each.

Note.—This bank of the river is intersected by small ravines with wooded margins, one of which is nearly opposite to chain 5, and another is near chain 13, and which cause most of the irregularity in the wooded outline.

8. It follows, in like manner, that on that side of a whirlwind in which the rotary motion coincides with the progressive movement, the prostrating power will not only be increased in its intensity, but will also be effective over a wider space; and that few, if any, of the prostrated bodies will be found to have been thrown backward.

In the case before us, as may be seen in the sketch, the prostrations are found to extend on the southern or right side of the apparent axis to a distance nearly twice as great as on the left side. The same general result has also been noticed in the tracks of other tornadoes which I have examined.

The facts here considered are too important to be overlooked, and seem fully to establish both the whirling action and the course of rotation.

9. If a rotative action be exhibited, the mean directions of all the prostrations, on each of the two opposite sides, will differ greatly in their respective inclinations to the line of progress, and the mean direction of those on the reverse side will be found more backward than on the opposite side, where the rotative course coincides with the progressive action.

In the case before us, the mean direction of all the prostrations on the right side of the track is found to incline 52 degrees inward from the line of progress. The course of the tornado is here taken to be east; although for the last half mile its course had been a little north of east. On the left side, the mean direction is found to be S. 3° W., or 93 degrees inward and backward; a difference in the mean inclination from the course on the two sides of 41 degrees.*

If we now take the indications afforded by the two exterior portions of the track, to the width of five chains on each side, where the effects are more distinctive in their character, we find on the right side a mean inward inclination of 46 degrees, the mean direction being N. 44° E.; while on the left side of the track the mean inclination is not only inward but 48 degrees backward, the mean direction on this side being S. 48° W. We have thus a mean difference in the inclination of the fallen trees, on the two exterior portions of the track, of no less than 92 degrees.

These indications seem conclusive, also, in favour of the whirling action in the direction from right to left.

10. Although of less importance, it should be mentioned that the diminished action of the tornado which is commonly observed on the hillsides and summits over which it passes, and the greatly increased action in the bottoms of the valleys, and even in deep ravines, afford

* The inclinations of the fallen trees from the course, on both sides of the axis, are reckoned inward and backward.

a strong argument against ascribing the effects to the ascent of a non-whirling rarefied column; as the latter, it would seem, must act with greater force on the hillsides and summits than in the bottoms of valleys. The general correctness of the observation above stated cannot justly be questioned.

11. The sudden and extraordinary diminution of the atmospheric pressure which is said to take place at the points successively passed over by a tornado, causing the doors and windows of buildings to burst outwards, seems to afford strong confirmation of a violent whirling motion; for an effect of this kind is necessarily due to the centrifugal and upward force of the vorticular action in the interior portion of the whirlwind. There are no other means known by which such an abstraction of pressure can be effected in the open air. An increase of calorific elasticity, if such were produced, either generally or locally, would not greatly disturb the equilibrium of pressure, being resisted by the surrounding and incumbent weight of the entire atmosphere. Besides, the immediate effect of such increased elasticity might rather be to burst *inward* the windows and doors of buildings exposed to its action.

Some of the more important indications mentioned above appear also from an examination of Prof. Bache's observations; although the latter are not definitely located by him, as regards the extreme borders of the track. Thus, in Fig. 7 of Professor Bache's paper, assuming the course of the tornado to be east, and rejecting a few observations near the centre, to avoid error, we find in twenty observations on the right side of the track, a mean inward inclination of 64 degrees; and for nine observations on the left side, a mean inclination, reckoned inward and backward from the course, of 104 degrees, being 14 degrees backward.

It is stated by Prof. Bache, "that the trees lying perpendicular to the track of the storm, are not those furthest from the centre of that track." This generalization accords with my own observations; but can hardly be reconciled with an inward non-whirling motion in the tornado.

It may appear to some, that in the case of a whirlwind the greater portion of the prostrations on the reverse side of the axis should be found in a backward direction; and so they would undoubtedly be found, were it not for the inward and the progressive action. But the force is here so far lessened by the reverse action above noticed, that in most cases only a small portion of the trees exposed will be thus prostrated; while the greatest force of the whirlwind, on this side, is felt near its last or closing portion and towards the apparent axis, where the inward, together with the rotative and progressive

forces, seem to combine their influence in the closing rush towards the heart of the receding vortex. This appears to account for the nearly opposite directions of prostration found on this side, and it is apparently by this more violent closing action, that many trees which were first overthrown in a direction nearly across the centre of the path, were again moved from their position, and swept onward nearly in the course of the tornado. It is proper to remark here, that an attentive examination of these effects has served to convince me that on the right and more central portions of the track the prostrations for the most part take place either at the outset or under the middle portions of the whirlwind; while on the left or reverse side, up to the line of the apparent axis, and even across the latter, they occur chiefly under the closing action of the whirl, as above described. The violent effects of this central and closing action are more clearly seen as we advance from the left-hand margin towards the centre or apparent axis of the path.

From the causes to which I have just alluded, the effects are usually more violent on and near the line passed over by the axis, than in other portions of the track. This line of greatest violence is found to coincide nearly with the line which separates the inwardly inclined prostrations of the two opposite sides of the track.* The latter line or apparent axis of the track is sometimes called the line of convergence, and is indicated on the figure by the line and arrow *c c.* Along this line, from the causes just mentioned, aided also by the elevating forces about the axis, many of the trees are swept onward, and left with their tops in a direction nearly parallel to the course of the tornado; forming an apparent, but not a just, exception, to the more lateral direction which pertains to most of the trees prostrated by the onset of the whirlwind, near the central portions of the track. Indeed, the central or closing violence of the advancing whirl is here so great, that the trees are not unfrequently torn out of the ground and carried onward to considerable distances.

It is proper to state here, that in the tracks of all the tornadoes which I have had opportunity to examine, and in some, at least, of those examined by others, the course of rotation has been found the same as in the case before us.†

In order to make a just and satisfactory examination of the effects of a tornado, it appears necessary to select portions of the track where the extension of wood or single trees, on each side, is found sufficient

* The line of greatest violence, for the most part, is found somewhat to the right of the line of convergence.

† As in the tornado which passed through Alleghany county, New York, July 25th, 1838; described by Mr. Gaylord in the American Journal of Science, vol. xxxvii, p. 92.

to mark clearly the exterior limits of the prostrating power, and where the effects on both sides of the axis are also clearly developed. Our next care should be to ascertain, as near as may be practicable, the line which separates the opposite convergence of the two sides, noticed above as the axis or line of convergence. We should then determine the general direction of this line and of the track at the place examined; which being done, we may proceed to measure the distance to which the prostrations are extended on each side, and then carefully to take the position and direction of prostration of each and of all of the fallen bodies, noting with care, also, any other phenomena which may serve to aid our inquiries. We may thus obtain valuable materials for future analysis; and this course of investigation, if faithfully pursued, will, it is believed, remove all reasonable doubt of the rotative action of these tornadoes. An examination of their probable origin, and the causes of their enduring activity and violence, belongs not to the present occasion.

New York, 5th February, 1841.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1840.

With Remarks and Exemplifications by the Editor.

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1. For an improved method of taking *Daguerrotype Likenesses by means of a Mirror;* Alex. S. Wolcott, city of New York, May 8. (See specification.)

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2. For an improvement in the *Stop-Cock for Water and Gas Pipes;* James Robertson, city of New York, May 8.

This stop-cock has a sliding valve resembling others which have been used, and it is so constructed as to admit of the easy sliding of the valve, and, at the same time, of its being pressed against its seat after it is in place; and also to admit of the cleansing of the chamber from any dirt that may accumulate within it.

The box is constructed as usual, with two side pieces, which fit into the pipe, and a top piece in which works the screw, which moves the valve up and down. The valve has three projections, one at top, with a vertical slot in which plays a projection from the nut that fits on the screw, and one ear at each side. The valve is pressed to its seat by what the patentee calls a "wedge," which is attached at top to the nut, and works up and down with it—it branches off, and each branch acts upon two projections on the back of the valve, one towards each edge. Each branch, at the edge, is provided with a projection which slides against the side of the box opposite to the valve seat. When the screw is turned with the view of shutting the

valve, the two branches of the wedge are resting on the top of the projections on the back of the valve plate, and thus as the wedge descends it carries the valve with it, without pressing it against its seat; but when the valve has reached the bottom, the two projections on the back of the branches of the wedge have reached two notches in the side plate of the box, which permit the branches of the wedge to slide over the projections on the back of the valve, and thus wedge it to its seat—the slot in the piece which projects from the upper part of the valve allowing the wedge to descend after the valve has reached the bottom. The bottom of the chamber is provided with a seat for a conical valve, which works up and down by means of a lever passing through the casing for that purpose—when the valve is lifted up the dirt passes out.

The claim is to "making the valve fit more firmly in its seat by means of the independent wedge, constructed and operating as described." And also to the "mode of cleansing the chamber from any dirt that may accumulate in it, by means of the escape valve, as described."

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3. For an improved *Tailor's Measure for taking measure for coats;* Richard Dame, Hanover, Grafton county, New Hampshire, May 8.

This is for improvements in what is generally known as the "Tailor's measuring square," and consists first of attaching an additional or extension branch at the end of the ordinary horizontal branch of the tailor's measuring square, at that end of it which forms the angle; and secondly, in providing the branches with sliding hinges, one half of each hinge being made to slide upon the branches, and the other having curved hooks, the points of which, in opening the hinges, catch the coat on the person to be measured, and then pass through holes in the other leaf, thus securing the instrument to the body—the claim is to the "attaching of the additional or extension branch at the end of the ordinary horizontal branch of the tailor's measuring square, by means of the hinge, and combining the branches and the sliding hinges for attaching said branches, as set forth."

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4. For a new mode of *Making Wigs;* Francis Bourgnet, city of New York, May 8.

Not being well versed in the art of making wigs, we will merely quote that part of the specification in which the inventor states the nature of his invention, and to this we will append his claim. "The nature of my invention consists in an apparatus whereby the pressure of the metallic spring may be varied at the will of the wearer." "What I claim as my invention, and desire to secure by letters patent, is the construction of the metallic wig with an additional transverse piece or spring, tempered soft, and flexible, so that it may be bent to any degree the wearer pleases, and of sufficient thickness to control the elastic spring, and keep it in the position to which it has been bent. I also claim the combination of the side plates for distributing the pressure with the transverse springs. Lastly, I claim in combination

with the above, the arch spring and oblique springs, the whole being constructed, and operating as herein described."

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5. For an improvement in the *Horse Power for driving machinery;* George Strenge, and Jacob Rohrer, Manhiem township, Lancaster county, Pennsylvania, May 8.

This is for an improvement in that kind of horse power in which the power is applied, by causing the horse to walk in a circle, and to draw by means of a lever or sweep, attached to a vertical shaft; and it consists in the peculiar manner in which the levers or sweeps are attached to the main driving wheel. The patentees observe that "sweeps of this description have heretofore been fastened to the main shaft in such manner as not to allow of their having any vertical play, in consequence of which, a considerable portion of the power of the horse or horses has been expended without the production of any useful effect, and has, in fact, been productive of injury, by racking the machine." In this machine the sweeps pass through staples attached to the main wheel, which staples are so formed as to confine the sweeps laterally, whilst they are allowed to play vertically. The inner ends of the sweeps are received within mortises in the upper end of the shaft, and there are springs on the upper and lower sides of the rear ends of the sweeps, which bear respectively upon the main driving wheel and upon the upper part of the staples. The upper springs are provided with an off-set to operate as a latch in confining the sweeps in place.

The claim is to the "allowing of a vertical play to the sweeps or levers, by causing springs to act upon their upper and lower sides, in the manner described."

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6. For improved *Brakes for Railroad Cars;* Matthew W. King, city of New York, May 8.

This brake is so constructed as to act against the insides of the two rails at the same time, there being two levers, each provided with a roller at its outer end. These levers are placed nearly at right angles to each other, and work on a stud suspended from the bottom of the car. Two connecting rods are jointed to each of these levers, and these connect them with a screw passing through a nut, so that when the said screw is turned one way, the rollers on the ends of the levers will be pressed against the insides of the rails, and when turned the other way, will be relieved from them. The screw is turned by means of a pinion attached to its outer end worked by a cog wheel, which can be actuated by the tender.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the compound lever brake, combined and arranged as herein described."

7. For an improvement in the method of *Teaching the art of writing;* called "the transparent writing guide;" William Davidson, city of New York, May 8.

The patentee says, "the nature of this invention consists in preparing the surface of a glass fixed in a frame, under which the copy to be imitated is placed, by rubbing over its surface a certain composition, which forms a surface that will receive an ink of a peculiar kind, transferred thereto by a pen of a peculiar construction, which prevents its too rapid flow, and consequent spreading. The copy to be imitated is prepared on paper of a yellowish hue, with ink made of Kremnitz *white* mixed with water, and a small quantity of gum Arabic, and placed under the glass."

The pen made use of is constructed in the following manner. "On the inside of a common steel pen is inserted a concave piece of steel having the same curvature with the pen, but not extending as far as its point by about a quarter of an inch. This piece of steel is to be cut off square at the end, and is to be so arranged in the pen as to retain the ink, while it does not interfere with its spring and proper shape; as it is intended that when the point of the pen is pressed upon the glass it shall yield and recede from the aforesaid piece of steel, which retains its original position, and thus the communication is cut off, and the ink is prevented from flowing too fast upon the glass. The surface of the glass must first be prepared for receiving the ink in the following manner. A composition of hard soap and English scouring sand, is formed into a cake of convenient size, and with this the surface of the glass is to be well rubbed; it will then retain the ink."

"What I claim as my invention, is the method of preparing the surface of the glass under which the copy to be imitated is placed, and on which the writing is performed, by rubbing it with a cake composed of hard soap and English scouring sand, as before described."

We are apprehensive that the patentee of the above invention has learned, since obtaining the above patent, that teachers of writing are a very obstinate class of men, preferring the old mode of teaching by pen, ink, and paper, to that by the aid of hard soap and *English* scouring sand.

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8. For an improvement in the *Tub Water Wheel;* Abijah Woodward, Athol, Worcester county, Massachusetts, May 8.

The claim appended to the specification of this patent, will give a sufficiently clear idea of the invention; viz: "What I claim as constituting my invention, is the enlarging of the lower end of the shaft of such a wheel by surrounding the same with a drum; upon which drum I place two rows of buckets in addition to, and in combination with the row of buckets used in the ordinary tub wheel; the whole being constructed and operating substantially as herein set forth."

9. For an improvement in the *Thrashing Machine;* Jesse Lincoln, Uniontown, Fayette county, Pennsylvania, May 8.

This patent is taken for a mode of carrying off the grain and straw from the machine after it has been thrashed, and thus separating them from each other. An endless belt of woven wire passes around a roller at each end of a frame placed immediately in front of that part of the thrasher at which the straw and grain are discharged, and as this endless screen moves around the rollers, it receives a "shaking" motion by the revolutions of what the patentee calls a "flat roller." The claim is to the "combination of the 'flat roller' with the revolving screen, as described."

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10. For an improvement in the *Dredging Machine for Docks, Rivers, &c. &c.;* Oliver Allen, Norwich, New London county, Connecticut, May 8.

This is an improvement on the dredging machine invented by Elisha H. Holmes, for which he received a patent on the 18th of November, 1830, and which is noticed in this journal, vol. vii, page 167. The scoop, as usual, has a handle to it, which passes through a loop in a standard at the side of the boat or scow, and this is drawn forward, in scooping, by a rope or chain attached to a bale, which passes around pullies on the end of two swinging levers projecting from a vertical shaft, and thence around two other pullies to the capstan. A rope is attached to the scoop, where it is connected to the handle, and passes over a pulley at the top of a mast or high standard. By regulating the length of this rope, the point to which the scoop swings back to recommence its operation is also regulated. The patentee says that the "main object of his improvement is so to construct the machine as that the scoop by which the earth is to be raised shall be taken back by its own gravity to any desired point on the bottom of the river, dock, or other water, where the excavating is to be effected, instead of drawing it back by manual labour, as has usually been done." The claim is to the manner in which the scoop is governed and directed by the combined operation of the levers, and the rope or line passing over a pulley on the mast or standard.

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11. For improvements in the *Winnowing Machine;* Abel and Asahel Lomax, Clinton county, Ohio, May 8.

The blower of this fanning instrument is formed with spiral vanes revolving in a cylindrical case open at one end to the atmosphere, the other being adapted to the shoe placed at the end of it. The shoe rocks upon a pivot and journal at the bottom, so that it has greater play at top than at the bottom. The patentees claim, "first the adapting of one end of the cylinder to the shoe, and thus having the air to pass from its end directly into the shoe. And secondly, the mode of arranging the shoe, by which greater motion is communicated to the upper than the lower part of it."

12. For an improvement in the *Garden Hoe;* Charles S. Horner, Boston, Massachusetts, May 8.

The claim appended to this specification explains the nature of the improvement; it is as follows, viz:

"What I claim is the mode herein described, of connecting the hoe plate and shank by forming the latter with a square head and riveting it to the outside of the blade, the shank having been passed through it, and passing an iron collar over the shank on the inside of the hoe plate, in the manner described, so as to confine the plate between said collar and the square head on the outside of it, by means of which arrangement I am enabled to give not only greater strength to the blade of the hoe, but to make the instrument more durable than hitherto constructed."

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13. For improvements in the manner of *Constructing Railroads;* which improvements are applicable to common roads and streets; William Russell, New York city, May 8.

The patentee says, "my invention consists in a new and improved manner of preparing and laying wooden blocks, either on the horse tracks for railroads, or on common roads and streets; and also in a new and improved mode of preparing the string pieces for railways."

"The track upon which horses are to travel upon railroads, and upon which horses and carriages are to pass on common roads and streets, I pave with blocks of wood, but these blocks I form, arrange, and sustain in a new and peculiar manner. Along the road, whether it be a railroad, common road, or street, I lay string pieces in such manner as to form and constitute an abutment on each side of the portion which is to be paved with wood, and these, as well as the wood pavement, I lay upon hemlock or other suitable plank, placed in double thicknesses, crossing each other diagonally, after having first duly graded and prepared the ground for their reception. When a railway is to be formed, I lay plate rails along the string pieces, and these plate rails I confine down by means of bolts and keys." The paving blocks are cut from scantling, diagonally, so that the grain of the wood is inclined instead of standing vertically, and the inside of the string pieces are inclined to correspond with the inclination of the blocks. Two rows of blocks incline one way, and the next two, the opposite way. The claim is to "the manner of forming the track or road, by the combination of the string pieces with sloping sides, and the wooden blocks cut from scantling, adapted to the said sloping sides, and resting on a foundation of boards or plank, as described."

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14. For an improvement in the *Life Preserver;* Ralph Bulkley, New York city, May 8.

Two hollow metallic tubes are attached to a belt, which belt buckles round the body, so as to bring one of the tubes under each arm—a strap attached to the belt passes over each shoulder, and one hangs

down from each side, with a loop at the bottom to answer the purpose of a stirrup, so as to relieve the arms or shoulders of a portion of the weight. The claim is to the "combination of the air-tight tubes with the belt, in the manner, and for the purpose described."

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15. For a mode of *Converting the Matresses of Ships, Boats, &c., into Life Preservers;* Henry Blake Bourne, New York city, May 8. (See specification.)

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16. For an improvement in the *Sparger used in the process of Brewing;* H. Jones Brooke, and Francis B. Longmire, city of Philadelphia, May 8.

The patentees say, "the apparatus or instrument, denominated a sparger, is employed for the purpose of distributing water upon the malt contained in the mashing tub, or tun, in order to extract the saccharine matter in the preparing of the wort. As heretofore made, the sparger has been made to revolve near the surface of the mash tub, by the aid of gearing from a steam engine or other motive power; it has been constructed at considerable expense, and from its complexity has been subject to wear, and get out of order. In our sparger, these difficulties are removed by rendering it self-acting, by causing it to operate upon the principle of 'Barker's mill.'" From the middle of the tub rises a vertical shaft, on which revolves the sparger, which consists of a receiver, or funnel, from which the water runs down two tubes into a receptacle at the bottom, and from this receptacle branch out four hollow arms, with apertures through which the water flows, actuating the apparatus by re-action. The claim is to the manner in which the patentees have combined the re-acting apparatus with the mashing tub, as described.

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17. For a mode of *Stopping leaks in Hose;* Ralph Bulkley, New York city, May 8.

This patent is taken for a mode of stopping breaches in leather hose, whether small or large. Small breaches, or holes, are to be closed by a conical screw plug with a flat head. The point of the screw is to be inserted in the aperture, which, by screwing, is gradually enlarged, embracing the screw until the water is prevented from flowing out. But if the aperture be a slit passing lengthwise, it may be temporarily repaired for use by two corresponding plates of metal, the one to be placed inside of the aperture, and of sufficient length to cover it, there being a corresponding plate upon the outside of the aperture; the two plates are to be drawn together by screws, previously fitted to them, thus firmly binding the edges of the leather between the said plates of metal. If the aperture be so large, or of a description that it cannot be secured by such screws or plates, then a section of metal, or other description of pipe or tube, of suitable dimensions, may be inserted within the defective part, and the apparatus denominated "*breach clogs,*" is to be applied thereto; but if the breach

required to be stopped, be not, in itself, large enough to admit of the application of the "breach clogs," the water hose may be severed by cutting it entirely across, or incisions of suitable extent may be made for the convenient and necessary application of the said apparatus. The claim is to the "mode of repairing lateral breaches in hose by means of screws, as set forth. Also of repairing larger breaches in the same by means of metallic plates and flexible tubes, inserted in hose, constructed and secured in the manner described."

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18. For improvements in the *Fire Escape;* William P. Withey, Hartford, Connecticut, May 12.

The patentee says, "the nature of my invention consists in a system of ladders sliding one within another, with a platform affixed on the top of the uppermost one. The ladders are supported by frame work erected on a circular, revolving base, to which the footing of the ladder is hinged. The ladder is elevated to any angle with the horizon by means of rigging of cord or chains, the whole being supported on an oblong horizontal platform, which is mounted on wheels, to facilitate transportation from place to place." "I do not claim as my invention the ladders, windlasses, pulleys, or any of the above described parts unconnectedly considered—nor do I claim as my invention any of the means by which the several parts are connected together. But what I claim as my invention, and desire to secure by letters patent, is the hinging of the railed platform to the top of the ladder, and rendering it capable of being adjusted to a horizontal position, whatever may be the inclination of the ladder, by means of the toothed segments, the whole being constructed and operating in the manner described."

The segments mentioned in the above claim are attached to the ladder, near the top of its upper section, and pass through holes in the platform, which is hinged to the top of the same section of the ladder; and, by means of pinions on a crank shaft working in standards attached to the said platform, the platform is made to assume any required position.

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19. For an improved machine for *Hulling Grain;* James M'Gregor, Saratoga, New York, May 12.

The first paragraph of the specification gives so clear an idea of the principle of this machine, that we shall merely quote it, together with the claim. "My grain and seed rubbing machine, consists, in general, of a circular disk affixed to a vertical shaft, and made to revolve within a stationary cylindrical case or drum, adapted thereto. Upon each side, and upon the edge of said disk, and upon the interior of each head, and on the rim of the drum, there are placed strips of metal, usually denominated flights, which have such a direction given to them as shall carry the grain from near the centre of the upper side of the disk, where it is fed in, towards its periphery; and then on the under side, from the periphery towards the centre, whence it is delivered; the grain or seed, during its passage, being kept under

pressure by the direction given to the flights, and also by means of a valve borne up against the aperture through which the grain or seed is to escape; a spring or weighted lever being applied thereto."

"What I claim as my invention, and desire to secure by letters patent, in the above described machine, is the manner in which I have combined and arranged the revolving disk, and the hollow drum or cylinder, with flights, or projecting pieces thereon, affixed in such a way as to carry the grain or seed, under considerable pressure, towards the periphery, on the upper side, and towards the centre on the under side of the revolving disk. I also claim in combination therewith, the valve bearing against the delivery opening, for the purpose of increasing the pressure to any desired extent."

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20. For an improvement in the *Franklin Cooking Stove;* J. Houghton, Ogden, Monroe county, New York, May 12.

The jambs, front plate, and top plate with two boiler holes, of the open Franklin cooking stove, are united together, and so arranged that they can be let down so as to bring the boiler holes directly over and near to the fire; for this purpose the jambs slide in holes made in the bottom plate, and a chain attached to the top winds around a shaft passing through the pipe, and having a crank attached to it. The front plate is made with openings like the front of a grate, so that when the front of the stove, top, and jambs, united together, are let down, the front will answer the purpose of the front of a grate. The flues are adapted to this arrangement. The claim is to "making the jambs of the stove, or Franklin, to lower through the apron of the same, so as to bring the boilers that are above the jambs immediately over the fire."

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21. For a machine for *Hulling Rice, Barley, Clover Seed, &c.;* Daniel Tomlinson, Brookfield, Fairfield county, Connecticut, May 12.

This machine consists of a horizontal case, and a cylinder capable of revolving therein. The end of the case which receives the grain is provided with a hopper, and around the opening which communicates with the hopper there are about six oblique wings. Within the case there are teeth arranged in rows; the first three rows of these are about one inch wide, thick in the middle, and tapering towards the edges—they project from the surface about half an inch, and are placed with their flattened surfaces at an angle of forty-five degrees with the longitudinal axis of the cylinder. The rest of the teeth are cylindrical. The opening at the discharging end of the case is provided with a sliding valve to regulate the discharge of the grain. "For most purposes," the patentee says, "the case is perforated with oblong apertures, say half an inch long, and one-twentieth of an inch wide, for the escape of the dust and dirt, but they are not to be so large as to suffer the grain to pass through." The teeth on the cylinder are arranged in the same manner as those within the case, excepting that the rows on the former work between those of the latter, and the cylinder at the receiving end instead of being provided with wings,

has inclined notches, to give free entrance to the grain. The claim is as follows. "What I claim as my invention, and desire to secure by letters patent, is the before described mode of producing any desirable amount of pressure on the materials to be hulled or cleaned, and continuing the same through the whole length of the cylinder, by the combined operation of the oblique teeth, the round teeth, and the sliding gate or issue—effected continually during the operation of the machine."

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22. For a mode of *Fastening Bedsteads;* William H. Sabin, New Milford, Susquehanna county, Pennsylvania, May 12.

This patent is for an improvement on the dovetail fastener, in which a dovetailed projection attached to the post fits into a corresponding recess in the end of the rail.

Dovetailed projections are attached to each post, one for each rail, by means of a ferule, or a segment of a ferule, which is let in and fastened to the post; and the dovetailed recess is made in the end of a ferule fitted to the end of the post. The patentee says, "I do not claim to be the inventor of dovetail fastenings for connecting the posts and rails of bedsteads. But what I do claim, is my improved mode of forming and affixing them by a cylindrical ferule, or segment of a ferule, to the post, and by a ferule to the rails, the end of which ferule is hollowed to adapt it to the post."

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23. For an improved *Sofa for Invalids;* Martin Engel, Borough of Easton, Northampton county, Pennsylvania, May 12.

The arrangement of means by which the sofa can be changed into a chair to recline in any position for the accommodation of an invalid could not be made very clear without drawings, and we will therefore merely state that the bottom of the sofa is made in sections hinged to one another, the middle part being permanent and one end hinged to it so as to be elevated for the back, the upper end of this being made in two parts, is hinged so as to fall back a little for the head. The other end is hinged to the permanent part so as let the legs down, the lower end of this section being so hinged as to make the foot board. The upper section for the back is raised by straps attached to circular arms on the bottom passing over a roller running from front to back under the arm of the sofa, and winding on a windlass below it, and the leg and foot board at the other end is let down and supported by straps winding around a windlass within the other arm piece. The permanent part of the bottom has a hole in it with a cover for the convenience of a patient who is unable to leave the couch.

The patentee says, "having thus fully described the manner in which I construct and arrange the respective parts of my sofa for invalids, and shown the use of those parts respectively, I do declare that I do not claim the so constructing of a sofa, or couch, as that the head and foot parts thereof may be raised or lowered to adapt it to the use of invalids, but what I do claim as constituting my invention.

and desire to secure by letters patent, is the peculiar and novel manner in which these objects are effected by me so as to render it more manageable and convenient than those heretofore constructed. That is to say, I claim the manner in which I have combined the windlass with the rising frame and the jointed arm in the head part, not intending to claim either of those parts separately but only in their entire combination as herein set forth; I in like manner claim the combination of the respective parts which constitute the lowering and elevating portions of the foot end divided into two parts widthwise, and connected and operating as a whole in the manner set forth."

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24. For an improved mode of making and affixing the *Ears and Bails, or Handles, of Pails, Kettles, Buckets, &c.;* John F. Phelps, city of New York, May 12.

The following extract from the specification will be sufficient to convey a clear idea of this improvement, viz: "In the ordinary method of affixing the ears and handles, or bails, of buckets, or other vessels, the ears are made to project above the rims of said buckets, or other vessels, and the wires, or round rods, of which the bails are formed are usually made to hook into said ears with their ends turned outwards. In my improved mode of constructing them the ears are placed entirely below the rim of the vessel and the ends of the bails are turned inwards, and are received and turned round within a concavity formed in the ear or in the vessel for that purpose. These ears may be riveted, screwed, or soldered, to the vessel according to circumstances, they may also be varied in form. What I claim as my invention, and desire to secure by letters patent, is the so constructing and affixing the ears and bails of buckets, or other vessels, of wood, or of metal, as that the hooks of the bails bent inwards shall be received and turn within a cavity prepared to receive them on the under side of the ears as described, the latter being attached so as to stand below the rims of the vessels to which they are affixed. I do not claim the mere turning of the hooks inwards, this having been before done, but I claim only the combination of the hooks and ears as above set forth."

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25. For improvements in *Dry Docks;* John S. Gilbert, city of New York, May 12.

(See specification.)

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26. For a method of *Preventing Explosions in Steam Boilers;* James Reid, Pawtucket, Providence county, Rhode Island, May 19.

The patentee says that "the object of his invention is to prevent the accumulation of the superabundance of caloric in the steam to such a degree as to produce injury or an explosion." And this he effects, or aims to effect, by means of an apparatus connected with the safety valve. A coiled tube closed at top and open at bottom is placed near the top of the boiler, its open end communicates with a

cistern containing mercury, and from near the bottom of this cistern rises a pipe which passes up through the top of it and opens into a tight cylinder provided with a float. The stem of the float is so connected with the lever of the safety valve, and when the float is raised to a certain height it is to open said valve. The tube first mentioned is filled with water, or gas, (the patentee prefers the former,) which is heated by the steam in the upper part of the boiler, thus generating steam in the tube which will press upon the top of the mercury contained in the cistern, and force it to raise up the pipe against the bottom of the float contained in the cylinder, and as this float rises it is to open the safety valve, by its connexion with the lever thereof. The claim is to the coiled tube, mercurial cistern, pipe, cylinder and float, in combination with the safety valve.

The objections which might be urged against the said device are of such a character as, we think, would fully show its inadequacy to the effecting of the object proposed; these we have neither time nor space to urge, nor will they be necessary to those who possess practical, and some scientific, knowledge.

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27. For an improved *Machine for Cleaning Grain;* Samuel Spangler, Stony Creek Township, Somerset county, Pennsylvania, May 19.

A blower similar to that used in the common wheat fan is made use of in this machine, and from the spout thereof arises a vertical trunk, or case, in which revolve three sets of fans or beaters one above the other, worked by bands passing over pullies on their shafts. Two sides of this case are perforated for the escape of dust, and an inclined, perforated plate is placed across the spout of the blower. The grain is fed in through an opening at the top of the case and passes out through an opening at the bottom.

The claim is to the fans in the case, as described, they being arranged one over the other in a perforated case so that they shall act both as beaters and fans in combination with the fan blower.

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28. For improvements in the *Floating Dry Dock;* William Thomas, St. Louis, Missouri, May 19.

This patent is for improvements on the floating dry docks noticed in the fourteenth volume of this Journal, page 232, and in the twenty-second volume, page 239, to the first of which the reader is referred for a description of its general principle, as also to page 336 of volume one, third series. At each end of each float a trunk rises vertically, divided by partitions into a pump well and ballast cistern. Each float is divided into separate chambers by tight bulk heads, and all the chambers are connected with the pump well by means of pipes governed by cocks and valves. The ballast cistern also communicates with the pump well by a valve. The patentee says, "the operation of this dock is by letting water into the pump well at each end of each float, by means of a cock turned by an iron rod which extends to the top of the trunk and from the wells into the several chambers through the several pipes, which pipes are opened and shut by rods

extending to the top of the trunk, and blocks and wooden cocks; and by pumping from the wells to the ballast cisterns the dock gradually sinks to the required depth, to admit the boat, or vessel, to pass free over the blocking, previously arranged to suit her bottom; the water is then shut off; the boat, or vessel, being placed and secured in her proper position, the pumping is commenced and continued until the deck of the dock is raised two or three inches above the water. During the process of sinking or raising the dock, the water is so regulated by letting it into the wells, and from them to the chambers, and by pumping into or discharging from the ballast cisterns, as to preserve an equilibrium at all times.

"What I claim as my invention, and desire to secure by letters patent, is the employment of the ballast cisterns in combination with the floats in the manner described. I also claim the making of the bulk heads which separate the chambers water-tight, so as to prevent the water from passing from one chamber to another except through the pipes governed by cocks as described. I also claim the mode of connecting the several chambers and the wells by means of water and air pipes governed by cocks, valves, or gates, for the purpose and in the manner described."

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29. For an improvement in *Pumps;* Lebbeus Caswell, Harrison, Cumberland county, Maine, May 19.

The alleged improvement consists in making one or more slits in the body of the pump so that the piston rod and the piston can be connected together through said slit or slits, and the piston be worked by a piston rod outside of the pump bore. The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the constructing of one or more slits in the lower part of the tube, or bore, of the pump, and connecting the piston rod with the movable piston by passing it through the same."

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30. For an improvement in *Rifles and other Fire Arms;* James R. Thomas, Collinsworth, Talbot county, Georgia, May 19.

This patent was granted for an improvement on that kind of guns in which a separate chamber, removable from the barrel, is used. The separate chamber is made with a projection around the forward end of the bore, which fits into a recess in the barrel, the breech of the gun being made to receive the said chamber. Near the top of the back end, the chamber is provided with a hole which receives the end of a spring bolt to hold it in place. The spring bolt is drawn back by a projection from the tumbler which acts against an offset on the bolt, so that in bringing the hammer to the half cock the spring bolt is drawn out clear of the hole in the back of the chamber, and on cocking, the projection on the tumbler clears the offset on the bolt, and allows it to return by the action of a spiral spring coiled around it. A part of the lower part of the back of the chamber is beveled off so that in putting in the chamber the beveled part will force back the spring-

bolt until the chamber is in place. When the hammer is at half cock the chamber is forced up out of its place by a pin passing through a hole in the bottom of the case which receives the chamber; this pin is attached to the end of a spring screwed to the under side of the barrel.

The claim is in the following words, viz: "having thus fully described the manner in which I construct the detached chambers and the parts of the rifle, or gun, with which they are immediately connected, what I claim as constituting my invention, and desire to secure by letters patent, is the constructing a detached chamber in the form and manner herein described and represented, and the so constructing the breech of the gun as to receive the same, so that said chamber may be held in place by the projecting end passing into the rear end of the barrel, and by the spring bolt entering the mortise in the back part of said chamber, and so that it will be removed in the act of cocking the gun, or rifle, by the action of the spring and pin, as herein described. I do not make claim to either of these parts taken individually, but I do claim the manner in which I have combined them with each other so as to co-operate together substantially in the manner and for the purposes set forth."

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31. For an improvement in the construction of *Bee Houses;* Robert Martin, Fairfield, Columbiana county, Ohio, May 19.

The improvement claimed in this patent is applied to that kind of bee house in which a number of hives are placed one above the other, and consists simply in making the bottom of each hive of an inclined board which carries all the dirt to the bottom and through a hole in the floor through which it passes to the next hive below, where the same thing takes place until all the dirt is discharged at the bottom hive in the house. The claim is to "the mode of removing the dirt from the top to the bottom of the house by means of the apertures in the floors and drawers combined so as to form a passage from the top to the bottom of the hives."

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32. For an improvement in the *Thrashing Machine;* David Stafford, Syracuse, Onondaga county, New York, May 19.

This improvement consists simply in making the feed board in two parts, and having the part next to the cylinder hinged and borne up by springs so as to yield should any hard substances, such as sticks, or stones, enter the machine. The claim is to "the manner of constructing the feeding table, or drop apron, with one section to drop with the hinge, or pivot, and with the springs or other means underneath to sustain the same, as described; and the object of which is to prevent injury and fracture to the machine."

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33. For a mode of *Applying Water to Propel Mills;* William Baker, Utica, New York, May 19.

The engine employed in this mode of applying water power is similar in construction to the rotary steam engine and pump noticed in

the twenty-sixth volume of this Journal, page 164, to which the reader is referred for a description of it. From the bottom of the case in which the cylindrical segments, against which the water acts, revolve, a hollow trunk, or conductor, descends to the reservoir in which the water is discharged. In applying the water, the conductor and case, in which the segments revolve, are filled with water from the top to the bottom of the reservoir, the whole height not being greater than thirty-two feet, or equal to one atmosphere, and as the segments revolve against air-tight packing, the whole column of water is sustained by the atmospheric pressure, so that there is an atmospheric pressure upon the flanches, or valves, of the revolving cylinders, and by this pressure the segments are actuated. The water is only required to be of sufficient height to cover the segments and keep a constant supply of the fluid. The patentee says, "what I claim as my invention is the method herein described of applying the atmospheric pressure to propel a revolving engine, or machine, by placing a conductor for the passage of the water below such engine, or machine, by the descent of the water in which conductor the pressure of the atmosphere is brought to bear on the engine, or machine, corresponding to the height of the column of water below it. I also claim the combination of the revolving cylinders, and the enclosure in which they are placed, with the conductor below said engine."

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34. For constructing the *Valves, or Boxes, and Chambers of Pumps for Raising Water;* Joseph Evans, Lebanon, Warren county, Ohio, May 25.

The bore of the pump from the seat of the lower box upwards is larger than below, to admit of the introduction and withdrawal of the chamber and its appendages. The lower box consists of a rim and arms connecting it with a hub, or centre piece, provided with a loop by which the whole is removed. The lower part of the rim is tapered and covered with leather so as to fit water tight against that part of the bore on which it rests. The chamber is made of copper, and its inner diameter is equal to the inner diameter of the rim of the lower box, but towards the bottom it swells out so as to receive the box within it, and the two are united by screws. The upper part of the chamber swells out trumpet shaped to fit the bore of the pump where it is provided with a band of leather. The upper box consists of a cylindrical rim united to the centre piece by arms, and it is covered with a circular piece of leather which answers the double purpose of valve and packing—the piston rod screws into the centre piece and embraces the leather valve.

The patentee says, "what I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and connected the copper tube, forming the chamber of my pump, with the lower box, or valve, and seat thereof, as described, and for the purpose set forth. I also claim the manner in which I have constructed the upper box, or valve, and seat, that is to say, the causing the

leather disk, which constitutes the valve, not only to operate as a valve but also as a packing to the piston."

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35. For a machine for *Washing Clothes;* Sewall Benson, Waterville, Kennebeck county, Maine, May 25.

The clothes to be washed are attached to a fluted wash board made in two parts, the lower one fixed at the bottom of a frame, and the other sliding in grooves in the side pieces of the said frame, so that after the clothes have been placed over the upper edge of the lower half of the wash board, the upper half is pressed on to them and thus holds them in place. When thus attached, the frame slides up and down vertically between two sets of rollers, the gudgeons of which work in semi-circular arms which are hinged to frame work. One of these frames rests against the side or end of the wash box, and the other has its lower end hinged to the bottom of the box, and its upper end is connected to a weighted lever which presses it against the clothes on the wash board, as they are worked up and down, and the rollers working in the ends of the vibrating semi-circular arms are thus enabled to accommodate themselves to the inequalities which the clothes may present. The frame of the wash board is worked up and down by being suspended to arms projecting from a rocking shaft. The patentee says, "I claim, &c., first, the manner in which I have arranged and combined the rollers on semi-circular arms vibrating on their centres upon vibrating arms, and regulated in their action by a lever borne up by means of a weight. Secondly, the combination of the rollers attached to the semi-circular arms with the vibrating frame and fluted wash boards."

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36. For an improved *Seed Planting Machine;* George Page, Baltimore, Maryland, May 25.

This patent was granted for improvements on that kind of planting machine in which the seeds to be planted are taken from a receptacle by cups attached to a belt passing around two rollers, one of them placed near the bottom of the receptacle, and the other at a suitable height above it; the seeds are put into a hopper, of which the receptacle constitutes a part, but is divided from the main body by means of a sliding shutter, not reaching to its bottom, thus admitting the seeds to pass into the receptacle, but not higher than the bottom of the shutter, thereby preventing their insinuating themselves between the belt and the lower roller. The second improvement consists in attaching to the frame of the machine, a wheel for marking the distance of the rows, this is attached by means of two rods which hook on to the said frame so that it can be reversed at pleasure. The claim is to "the manner of combining the hopper and the receptacle with the sliding shutter, so as to govern the level of the seed in said receptacle, and thus to regulate the feed, in combination with the elevating belt; and also the attaching of a separate marking wheel to the frame of the planter as described."

37. For a mode of making *Metallic Sleigh Runners;* Arunah Spear, Braintree, Orange county, Vermont, May 25.

The patentee says, "the shoe, hub, and raves are connected together by a panel crossing alternately from one side of the runner to the other. This panel is made a little thicker directly under the hub than it is at each end of the runner. The panel and raves so connect the hub and shoe as to form merely, if not quite, a universal brace, in every point liable to exposure or injury. The panel, crossing the runner alternately, places the edges, liable to be broken, at a much greater distance than the mere thickness of the panel, thereby greatly increasing the strength, with but a small increase of weight. What I claim, &c., is the construction of the runners of a sleigh of iron, or other metal, in the manner above set forth, so as to cause the strain, arising from a pressure on one side of the runner, and a pulling on the other, in a manner tending to break the same, to act mainly on the edge of a thin piece of iron, or other metal, thereby avoiding an inconvenient weight, and preventing the centre from operating as a fulcrum over which to break the sides of the runner, rave, or panel."

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38. For a *Life Preserver, or Buoyant Dress;* Rufus Porter, Bellerica, Middlesex county, Massachusetts, May 25.

This dress is made like a pair of pantaloons, with boots, and extending to the arms, with straps passing over the shoulders. A buoyant circle is made around the body of the dress in several separate air-tight chambers, each provided with an inflating tube; and to each leg is attached a set of circular fins, made like a parashute, which open when moving the leg down, and close when moving up. The claim is to "the making the buoyant circle in several separate air-tight chambers, each provided with a tube for inflating, as described; and also the circular fins or paddles, in combination with the water-proof garment."

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39. For an improved mode of *Making the Clasps for Mail Bags;* James Sellers, and Abraham L. Pennock, Philadelphia, Pennsylvania, May 25.

This invention consists in making the clasp of hickory, or other kind of hard, tough wood, instead of forming it of iron, steel, or other metal. A piece of wood is steamed and bent in a mould of the desired shape, and there retained until it becomes set—it is then divided in two parts, longitudinally, is mounted with hinges, &c. &c., and then the leather is secured to it by rivets. The claim is to "the constructing of a clasp composed entirely of wood, and the adapting the same to, and combining it with bags, for the conveyance of letters, traveling bags, or valises, and such others to which it may be adapted; the said clasps being connected together by hinges of metal, by links, or by any flexible material which may be preferred."

40. For an improvement in the *Cooking Stove;* William Jeanes, Philadelphia, Pennsylvania, May 25.

The base of the stove, which is rectangular, is divided into three chambers by two partitions. The box, or body of the stove which contains the oven, is also rectangular, and stands upon the fire cylinder or furnace, which is cylindrical, and upon four columns or pipes, one at each corner. These pipes open below into two chambers, one on each side of the ash drawer, thus making flues leading from one pipe to the other on each side of the stove, and at their upper end these pipes open into the compartments into which the body of the stove is divided. There is also an opening in the bottom plate of the body of the stove communicating with the furnace. Between the bottom plate of the body or box of the stove, and the bottom plate of the oven, there is sufficient space for the flue, and a similar space is left between the top plate of the oven and the top plate of the box. A partition plate passes from end to end of the box or body of the stove, outside the oven, dividing it into front and back chambers; this partition extends from the top plate and down at each end to the bottom plate. Through this partition there is an opening immediately above the oven, which constitutes the only communication between the front and back compartments of the box, excepting through the columns. This opening can be closed at pleasure, by a sliding damper. The end plates of the oven in the back compartments extend down to the bottom plate of the box, so that all direct communication with the flue under the oven, and with the back compartments, is cut off. The smoke pipe on the top plate is placed over that part of the flue above the oven which is behind the partition.

The patentee says, "what I claim is the particular manner in which I have constructed, arranged, and governed the passages for the draught from the fire, as above described. That is to say, the manner in which I have divided the box or body of the stove containing the oven, into two chambers or compartments, by means of the partition, cutting off all communication between said compartments, excepting through the opening in said partition, or through the columns," &c. &c.

Specifications of American Patents.

Specification of a patent for an improved apparatus for taking Daguerreotype Likenesses. Granted to Alexander J. Wolcott, *city of New York, May 8th,* 1840.

To all to whom these presents shall come: Be it known that I, Alexander S. Wolcott, of the city of New York, and State of New York, have invented a new and improved method of taking likenesses from life, of which the following is a full and exact description. At one end of a box a concave reflector (which may either be a piece of solid metal, or of glass silvered,) is placed, with the reflecting surface facing the other end, which has an opening corresponding to the size

of the reflector. In this opening is a light metal frame fixed by a thin support to a piece of wood or other material, with which it slides on the bottom of the box, in a direction perpendicular to the face of the reflector and length of the box; this frame is intended to carry the metallic plate, paper, or other material, on which the impression is to be made—the plate, paper, or other material, may be retained in the proper position against the frame by a small spring, pressing the plate, paper, or other material, on the back, and between which spring and the frame, the plate, paper, or other material, is slid. A small door should be made on the top of the box for the purpose of observing the focal image. The box should be placed on a table, or other support, at such height that the centre of the reflector may be as high as that part of the person which is intended to be in the middle of the picture; when a very small picture of the person is intended to be taken, the focus may be adjusted by a microscope, which may be introduced through a hole in the top or side of the bóx, or held by the hand, at the door-way on the top. When the camera (that is the box with the reflector,) is to be used, the person whose likeness is to be taken, should be placed in a chair, to which some suitable support for the head is attached, to enable him to remain perfectly still. The camera should then be placed with the open end immediately opposite to the person, a trial plate is then to be placed or put against the frame that stands in the open end of the box, and the focus adjusted by sliding the piece to which it is attached; the trial plate is then to be removed, and the plate, paper, or other material, (prepared in any of the well known methods for being acted on by luminous or other rays,) put into its place, and allowed to remain as long as required, to form the image. A convenient size for such camera would be as follows: the box inside, fifteen inches long, eight and a half inches high, and eight inches wide. Reflector, seven inches clear diameter, and twelve inches focus. The plate, paper, or other material, on which the picture is to be formed, is two and a half inches long by two inches wide.

For taking likenesses for breast pins, the reflector may be about two and a quarter inches diameter, and four inches focus, and all the other parts of the camera of proportionate size. That which I claim as my invention, and desire to secure by letters patent, is the taking of likenesses from life, by the aid of a concave reflector placed so as to receive the rays from the person whose likeness is to be taken, and converge them to a focus, on a prepared plate, paper, or other material placed between the person and the reflector.

Alexander J. Wolcott.

Specification of a patent for an improved mode of converting Matresses into Life Preservers. Granted to Henry Blake Bourne, *city of New York, May 8th,* 1840.

To all whom it may concern: Be it known that I, Henry Blake Bourne, of the city of New York, and State of New York, have invent-

ed a new and useful arrangement, for the purpose of converting the matress, or matresses, of ships, steamboats, and all passage vessels, into a preserver of life and property, and I do hereby declare that the following is a full and exact description. The nature of my invention consists of the peculiar arrangement and adaptation of the common berth matresses now in use, into a life and property preserver. To enable others to make and use my invention, I will proceed to describe its construction and operation; I take a common berth matress (hair or spring,) measuring, generally, some six feet in length, two feet four inches in width, and about six inches in depth, and intersect it in the narrow sides; I then remove the hair, or whatever it is stuffed with, and cover the surface of each open half with common ticking, or any other fabric, forming two separate matresses. I make two water-proof chambers of the length and depth of each half matress, and about one-third or one-quarter of their width, and stuff them with broken cork, or with hair, or whatever occupied the same place before, or with a mixture of hair and cork, and insert one lengthwise into each half matress, against one of its longitudinal edges, replacing the remainder of the stuffing into the other part of each half matress, and sew them up, thus forming two separate matresses stuffed as before, with a part of each water-proof and buoyant. A double-bladed oar is secured on one of the edges of one-half matress, and two shoulder-straps on one of the edges of both half matresses.

I then form a separate water-proof chamber or enclosure, having two sides of corresponding area with the broad surface of the matresses, or less, and I join the upper and lower longitudinal edges by a diamond-shaped slip of water-proof cloth. In the centre of one of the slips is an aperture, with a band around it, and running string, and to the other, two water-proof leggins are attached. There is a slip about two inches wide projecting over the longitudinal edges, circumscribing the two diamond-shaped slips, to which the half matresses, (the water-proof enclosure being laid between them) are buttoned, sewn, or anywise fastened. The operation may be as follows.

When used as a matress to sleep upon, the legs are laid underneath, the oar and straps lying against either side of the berth, and it then differs in no respect from those in present use; but on an emergency, the tenant of the berth thus provided, takes the article out, places in the water-proof enclosure through the aperture, whatever valuables he may desire, or have time to preserve, papers, monies, clothes, and provisions for many days; he then puts his feet into the leggins, draws the string around the aperture close round his chest, and by placing his arms under the shoulder straps, he is enabled by the leggins to go on deck and jump overboard—when in the water, he can use the oar attached to navigate with; the depth of the matresses will protect his vitals, and, when on shore, the leggins again enable him to retreat beyond the reach of the returning wave. The article, if preserved, will answer as such again, being capable of all necessary repairs.

What I claim as my invention, and desire to secure by letters patent, is the method of adapting the common berth matresses to a life and property preserver, by making a water-tight chamber, pro-

vided with leggins between the two halves of the matresses, for the purpose, and in the manner described. I also claim the making a portion of each half of the matresses buoyant, for the purpose, and in the manner described.

HENRY BLAKE BOURNE.

Specification of a patent for an improved mode of constructing Dry Docks. Granted to JOHN S. GILBERT, *city of New York, May 12th*, 1840.

To all to whom these presents shall come, be it known that I, John S. Gilbert, of the city of New York, in the county and State of New York, Engineer, have invented certain new and useful improvements in the construction of dry docks, to be of wood or of sheet iron, the bottom to be strengthened with timbers, which I term clamps and buttresses. Also a water stopper for preventing leakage at the entrance gates, which I term a hydrostatic water stopper, of which improvements the following is a full and exact description.

The buttresses are timbers bolted one upon the top of another, starting on the upper clamps (to which they are fastened,) far within a plumb line dropped from the side of the largest ships, for which the dock is intended, thence running up on such angle as shall leave breadth opposite the bilge of the ship (when she sets on the blocks,) sufficient to enable the workmen to stand upon them and caulk, or otherwise repair, the bottom of the ship. As a general rule, I divide the width of the dock into three equal parts, the lower edge of the buttresses extend across one-third of the bottom on each side, and thence run upon such angle as shall intersect with the upper edge of the perpendicular sides of the dock. By this mode of construction, only one-third of the transverse section of my dock is left unsupported, (except by the timber under the keel.) This method, I have reason to suppose, is an improvement on the usual method of building floating docks, inasmuch as I can build my dock wider, and yet leave less width of bottom unsupported; by means of this increased width I obtain a greater degree of light at the keel of the ship, and likewise a greater degree of steadiness, and when the inner or slanting sides of these buttresses are planked up, if such should be deemed advisable, it will form a dock that will retain less water after the ship is floated in, than any other form, shape, or construction.

The bottom and buttresses thus combined, form as near as may be, an inverted arch to the buttresses. Shores are attached, with joints to allow of their being made to rest against the dock frame or sides of the ship, thereby forming, as near as may be, an opposite arch to that formed by the bottom and buttresses. It will be seen, upon examination, that no brace work, or other mechanical contrivance, can offer so perfect a resistance to the upward and lateral pressure of the water as these solid dead woods, as they depend entirely upon their own strength.

The advantage which I derive from this my method of construct-

ing and strengthening the bottom of my dock are various, amongst the most important is that of being able to operate with it in shoal water; for, as the quantity of timber required to be laid crosswise to give to the bottom of the dock sufficient strength to sustain the weight of the class of ships for which it is intended, must depend mainly upon the length of said cross timbers between supporters; it will be seen at once that my plan of letting the buttresses extend from the sides of the dock at least one-third across the bottom on each side, shortens that part which cannot be strengthened but by an increase of timber placed under the keel, and consequently I am enabled to set the keel of the ship much lower than by any other mode of construction. No allowance need be made for the lower clamps, in calculating the depth of water to operate in, as they will settle into the mud.

Another advantage of my plan is, that I have dispensed with all water-tight chambers below the keel, in the middle of the dock, the workmen can therefore stand upon the lowest point in the dock, and as a part of the cross timbers are below, or on the under side of the bottom, they can easily step over the upper clamps, which would be difficult if they were all on top. Another and still greater advantage to be derived from this, my plan, is the perfect security against leakage. The usual method of constructing single bottom docks, as well as ships and other floating vessels, is to fasten the planks on the under side of all the floor timbers, the caulked joints are thereby brought (especially in the case of docks,) on the outer line of the circle given to the bottom of the dock by the weight of the ship resting on the centre blocks, it has been found impossible to keep the bottom joints from opening and shutting.

The method by which I fasten my dock together is to bolt the bottom on to the lower clamps, and caulk it on the upper side, the upper clamps are then placed directly over them, and are bolted through and through. Supposing the upper clamps to contract as much as the lower ones expand, there will be no important effect produced upon the caulked joints. But in addition to all the advantages to be derived from this my method, as above set forth, I am enabled by the use of the upper and lower clamps, to build my dock in the water, instead of the usual and expensive method of building on the land, and I thereby save the trouble and danger of launching. The buoyancy of the lower clamps may be increased if it is not sufficient, by other buoyants, until the fore and aft timbers that form the tight bottom are fastened and caulked; the streaks and layers of timbers that form the sides are caulked as they are laid up, so that the joint to be caulked is always above water. The hydrostatic stopper is a leathern hose, or hose of other flexible water-tight substance, placed in a groove, of half a circle, more or less, cut into the frame, made of the shape of the entrance of the dock, or other parts of the dock, where its use may be required as a water stopper, so that the frame may be removed, if necessary, in order to repair the hose. The manner in which I apply the said water stopper is to fill it after the entrance gates are closed, with water or other liquid, so that an outer

pressure is produced sufficient to stop the water from passing between the hose and gate. When the dock is to be filled with water, in order to float out the ship, the liquid is drawn off through a faucet.

Having thus fully described the manner in which I construct the bottom and buttresses of my dock, and also the mode of using my hydrostatic water stopper, I do hereby declare that what I claim therein as my own invention, and desire to secure by letters patent, is, first, the particular manner of arranging the cross timbers by placing a part below, and a part above, the caulked bottom, thereby securing said caulked bottom between clamps, for the purpose of preventing the opening and shutting of said caulked seams, &c. Second, the employment of a hydrostatic water stopper, for the purpose, and in the manner heretofore described in this specification. In testimony whereof, I, the said John S. Gilbert, hereunto subscribe my name in the presence of the witnesses whose names are hereto subscribed, on the 22nd day of April, A. D., 1840.

JOHN S. GILBERT.

Application of the process of Gilding in the moist way, to the Art of Engraving.

(Extract of a Letter from Professor DELA RIVE to M. DUMAS.)

Mr. Hamman, an engraver of our city, (Geneva,) has just made an interesting application of my process of gilding, to the art of engraving, by aquafortis. He gilds the plate of copper designed to receive the engraving, instead of covering it with wax, and then traces upon its surface the lines of his design, removing the gold wherever the point passes. He then spreads over it the aquafortis, which attacks and corrodes the copper wherever it is exposed. This process seems to have several advantages over that in which wax is employed. In the first place, the coating of gold being permanent, the plate may be corrected if the proofs show faults; in the other process, when the wax is removed, it is very difficult to make any corrections. Moreover, the lines which are traced upon the coating of gold may be made much more fine and delicate than those which we find upon wax. It appears that gilding by mercury, besides being much more expensive, does not present the same advantages and facilities in application.

Annales de Chemie et de Physique.

LUNAR OCCULTATIONS FOR PHILADELPHIA, AUGUST, 1841. COMPUTED BY JOHN DOWNES.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞For direct vision add 180°.☜	
Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	15	59	Im. 19 Capricorni, Em.	6 *invisible.*	99°	41°
19	7	32	Im. *q* Virginis, Em.	5.6 *invisible.*	99	147

Meteorological Observations for May, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	46	54	29.35	29.35	W.	Brisk.		Cloudy—flying clouds.
	2	44	50	.64	.45	W.	do.	.06	Cloudy—shower—hail.
	3	31	48	.76	.80	W.	do.		Clear—frost—cloudy.
	4	34	50	.84	.86	W.	do.		Clear—do
☉	5	33	56	.80	.80	W.S.	Mod-rate.	.33	Clear—white frost—rain.
	6	42	58	.75	.80	W.	Brisk.		Clear—flying clouds.
	7	40	52	30.10	30.00	NW.	Moderate.		Clear—cloudy.
	8	44	57	29.80	29 90	NE.	do.	.65	Rain—cloudy.
	9	45	70	30. 0	30.08	W.	do.		Clear—hazy.
	10	50	59	29.80	29 55	E.	do.	.45	Rain—do.
	11	51	65	.40	.40	W.	Brisk.		Clear—flying clouds.
	12	54	64	.43	.43	W.	Calm.	.14	Cloudy—showery.
☽	13	45	64	.65	.65	W.	Moderate.	.13	Clear—shower.
	14	41	62	.70	.73	W.	do.	.07	Clear—shower.
	15	42	64	.85	.90	W.	do.		Clear—flying clouds.
	16	42	64	.96	.96	E. SW.	do.		Clear—flying clouds.
	17	52	64	.85	.60	W.	Brisk.	.01	Cloudy—shower.
	18	46	66	.75	.76	W.	do.		Clear—flying clouds.
	19	46	66	.80	.84	W.	Moderate.		Partially cloudy—do. do.
⊗	20	44	71	.94	30.09	W.	do.		Partially cloudy—clear.
	21	48	78	30 00	.00	SW.	do.		Clear—do.
	22	57	86	29.9	.00	W. SW.	do.		Hazy—do.
	23	66	83	96	.00	SW.	do.		Cloudy—clear.
	24	62	84	30 00	.00	SW.	do.		Partially cloudy—clear.
	25	63	84	.00	29 93	SW	Brisk.	.43	Clear—thunder shower.
	26	64	73	29.90	.90	SW.	Moderate.	.53	Cloudy—rain—cloudy.
☾	27	63	70	.90	.95	SE.	do.	.13	Cloudy—rain.
	28	64	81	.95	.98	S	do.		Fog—flying clouds.
	29	66	80	.95	.93	W.	do.	.02	Drizzle—partially cloudy.
	30	60	70	.90	.96	E.	do.	.05	Drizzle—cloudy.
	31	50	73	30.00	.93	E.	do.		Clear—do.
	Mean	49.52	66.68	29.83	29.83			3 010	

	Thermometer.		Barometer.	
Maximum height during the month,	86 00	on the 27th.	30.10	on the 7th and 9th.
Minimum " "	31 00	" 3rd.	29.35	" 1st.
Mean	58.10		29.83	

	Collat… olo… var…		Maximum N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Pl											
2	M	0.										
3	B		$6\frac{1}{3}$	.	$\frac{1}{3}$	$1\frac{1}{3}$	....	.	.....	....	.	1395
4	L											
5	N	0.										
6	M		2	.	.	$8\frac{1}{3}$	....	.	.....	....	.	1353
7	P											
8	W	8.										
9	S		$6\frac{2}{3}$	.	.	.	....	.	.....	....	.	1403
10	L	0.										
11	S	0.	$3\frac{1}{3}$	.	$4\frac{1}{3}$	$\frac{1}{3}$	....	.	.....	....	.	1362
12	B	0.	$9\frac{2}{3}$	.	.	.	....	.	......	....	.	1350
13	C	0.	$7\frac{1}{3}$	2	.	.	....	.	.....	....	.	1344
14	D	0.	$8\frac{2}{3}$	$1\frac{2}{3}$	$\frac{1}{3}$	.	37.35	5	.....	....	.	1348
15	L		$3\frac{1}{3}$	$1\frac{2}{3}$	.	$\frac{2}{3}$	25.45	1	......	32.63	1	1370
16	Y											
17	D	0.										
18	D	0.	$1\frac{1}{3}$	.	.	$\frac{1}{3}$	....	.	......	....	.	1345
19	N		$2\frac{1}{3}$	.	4	.	....	.	.....	....	.	1343
20	C											
21	F											
22	T											
23	I											
24	U											
25	N	0.2										
26	J		$5\frac{2}{3}$	.	$17\frac{1}{3}$	$1\frac{2}{3}$	....	.	.....	....	.	1346
27	I											
28		30.0										
29	A		1	.	3	.	18.50	7	.....	28.70	7	1375
30		29.9										
31		29.9	.	.	.	1	....	.	.....	....	.	1367
32			1	$\frac{2}{3}$	$\frac{1}{3}$	21	....	.	.....	....	.	1371
33		...										
34			$2\frac{1}{3}$	.	.	$1\frac{1}{3}$	....	.	.....	....	.	1368
35		28.2										
36		29.7	$2\frac{1}{3}$	.	$1\frac{2}{3}$	2	....	.	.....	....	.	1351
37		28.1	$4\frac{1}{3}$	.	.	.	....	.	.. .	....	.	1347
38		29.1	.	.	$9\frac{1}{3}$	6	....	.	.....	....	.	1363
39			.	.	$8\frac{2}{3}$	.	....	.	...	....	.	1354
40		29.1										
41		29.5	2	.	$1\frac{2}{3}$	$1\frac{2}{3}$	....	.	......	....	.	1360
42			$3\frac{2}{3}$	.	.	1	....	.	.....	....	.	1359
43												
44		29.6										
45			$5\frac{2}{3}$	.	$2\frac{1}{3}$	.	....	.	.....	....	.	1442
46												
47		29.8										
48		30.3	$4\frac{1}{3}$	1	$5\frac{2}{3}$	$3\frac{2}{3}$	....	.	......	....	.	1358
49		29.3	$4\frac{1}{3}$	.	2	$\frac{2}{3}$	....	.	......	....	.	1380
50			$\frac{2}{3}$	.	.	.	....	.	.....	....	.	1349
51												
52												
53												

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METEOROLOGICAL REPORT
FOR THE STATE OF PENNSYLVANIA,
Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for
JANUARY, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1 Philadelphia, .	Philadelphia, .	G. P. Schively, .										
2 Montgomery, .												
3 Bucks, .	Newtown, .	L. H. Parsons, .	27.39	36.39	30.58	48.00	1.00	31.45	.	0.75	24.99	.
4 Lehigh,												
5 Northampton,	Easton, .	Charles Elliot, .										
6 Monroe .	Stroudsburg, .	A. M. Stokes, .	22.08	30.14	22.60	55.00	—16.00	29.94	11⅔	....	....	.
7 Pike, .	Milford, .	Ralph Bull, .										
8 Wayne, .	Hone-dale, .	W. Richardson, .										
9 Susquehanna,	Silver Lake, .	E. Rose, .	18.71	26.03	21.65	42.00	—10.00	22.13	.	—10.00	18.19	.
10 Luzerne, .	Wilkesbarre, .	W. F. Dennis, .										
11 Schuylkill, .	Port Carbon .	P. C. Lyceum, .	24.92	35.18	26.75	52.00	—20.50	28.95	⅓	—15.00	20.84	.
12 Berks, .	Reading, .	C. F. Egelmann,	26.26	32.42	28.23	54.00	—2.00	28.97	.	...	...	.
13 Chester, .	West Chester,	Wm. W. Jefferies, .	28.24	35.02	29.98	56.50	—5.00	31.08	.	—5.00	25.32	.
14 Delaware, .	Haverford, .	Haverford School, .	29.29	32.97	31.32	56.00	2.00	31.19	.	—1.00	23.86	2
15 Lancaster, .	Lancaster, .	Conservatory of Arts,	26.69	35.25	28.88	55.00	—7.00	30.27	⅔	—7.00	23.69	.
16 York, .												
17 Lebanon, .												
18 Dauphin, .	Harrisburg, .	J. Heiseley, .	26.97	31.20	29.74	45.00	—2.00	29.30	⅓	—2.00	27.71	.
19 Northumberland,	Northumberland,	Andrew C. Huston,	23.19	32.22	26.26	50.00	—21.00	27.22	.	—23.00	17.09	.
20 Columbia, .	Danville,	C. H. Frick.										
21 Bradford, .												
22 Tioga, .												
23 Lycoming, .												
24 Union, .												
25 Mifflin, .												
26 Juniata, .	Mifflintown, .	J. A. Kinkead, .	21.52	32.85	23.83	46.00	—14.00	26.07	1⅔	....	....	.
27 Perry, .												
28 Cumberland, .	Carlisle, .	Prof. W. H. Allen,										
29 Adams, .	Gettysburg, .	Prof. M. Jacobs, .	23.57	33.70	36.37	48.50	—10.00	27.88	.	—16.00	21.69	.
30 Franklin, .												
31 Huntingdon, .	Huntingdon, .	Prof. Jacob Miller,	22.19	32.43	25.52	44.00	—16.00	26.35	1	....	....	.
32 Centre, .	Bellefonte, .	John Harris, .	16.76	34.17	24.26	48.00	—25.00	25.06	13	....	....	.
33 Potter, .												
34 M'Kean, .	Smithport, .	M. R. Atkins, .	20.74	27.97	24.19	49.00	—18.00	24.30	.	....	....	.
35 Clearfield, .												
36 Cambria, .	Ebensburgh, .	Richard Lewis, .	21.29	27.88	22.80	46.00	—15.00	23.99	2	—15.50	20.02	.
37 Bedford, .	Bedford, .	Samuel Brown, .	23.74	35.62	27.97	51.00	—12.00	29.11	.	....	....	.
38 Somerset, .	Somerset, .	George Mowry, .	26.30	32.98	27.96	48.00	—10.00	29.08	6	—10.00	23.91	8
39 Indiana, .	Indiana, .	Richard White, .	29.97	33.48	27.74	50.00	—15.00	30.40	.	....	....	.
40 Jefferson, .	Rose Cottage,	C. C. Gaskell, .										
41 Warren, .	Warren, .	J. E. King, .	31.97	35.79	28.72	54.00	2.00	32.16	1⅔	....	....	.
42 Venango, .	Franklin, .	Wm. Connely, .	22.45	33.71	25.00	55.00	—20.00	27.05	.	....	....	.
43 Armstrong, .												
44 Westmoreland,												
45 Fayette, .	Uniontown, .	J. P. Weethee, .	29.19	37.05	28.53	59.00	—24.00	31.59	.	....	....	.
46 Green, .												
47 Washington, .	Cannonsburg,	Prof. A. H. Campbell,										
48 Alleghany, .	Pittsburgh, .	J. P. Bakewell, .	26.50	34.78	29.50	56.00	—6.00	30.26	3	....	....	.
49 Beaver, .	Beaver, .	James Allison, .	26.42	34.96	28.29	53.00	—2.00	29.89	⅔	....	....	.
50 Butler, .	Butler, .	Jacob Mechling, .	28.00	33.61	31.00	50.00	—10.00	30.87	.	....	....	.
51 Mercer, .	West Greenfield,	S. Campbell, .										
52 Crawford, .	Meadville, .	J. Limber, .										
53 Erie, .	Erie, .	Park & Reid, .										

County.	Barometer, 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
3 Bucks	30.10	30.09	30.11	30.78	29.36	30.10	.	7⅔	23	⅓	7	1	4	..	7.037
6 Monroe	29.54	29.54	29.46	30.20	29.30	29.51	7⅔	5⅓	15⅔	10	3	6	....	..	3.591
9 Susquehanna	28.06	28.05	28.02	28.35	27.60	28.04	.	7	24	.	2	8	....	..	1.591
11 Schuylkill	29.42	29.39	29.39	30.02	29.03	29.40	⅓	7⅔	23	⅓	6	8	1	..	......
12 Berks	29.89	29.85	29.87	30.50	29.15	29.87	.	7⅔	23⅓	.	5	5	3	..	......
13 Chester	29.94	29.95	29.93	30.42	29.60	29.94	.	.	.	.	5	5	4	..	......
14 Delaware	29.61	29.56	29.59	30.16	29.08	29.59	.	9⅓	21⅔	.	....	....	....	..	4.615
15 Lancaster	29.51	29.45	29.49	30.15	28.78	29.48	⅔	9	21⅓	⅔	9	4	4	..	6.430
18 Dauphin	29.85	29.82	29.83	30.55	29.30	29.83	⅓	9⅔	21⅓	.	7	5	3	..	.. ...
19 Northumberland	29.46	29.41	29.45	30.10	28.86	29.41	.	5	25⅔	⅓	7	7	4	..	5.256
26 Juniata	29.53	29.47	29.51	30.21	28.92	29.50	2	5	23⅔	2⅓	3	4	1	..	3.620
29 Adams	29.40	29.35	29.37	30.05	28.81	29.38	.	10	21	.	15	2	....	..	6.353
31 Huntingdon	29.35	29.35	29.32	29.96	28.80	29.34	1	9	22	.	1	5	1	..	2.543
32 Centre	29.32	29.22	29.33	29.90	28.70	29.29	12⅓	3⅔	14⅓	13	1	4	....	..	......
34 M'Kean	....	....	....	....	....	....	.	8⅓	21⅓	1⅓	2	13	1	..	4.600
36 Cambria	27.77	27.76	27.77	28.21	27.22	27.77	2	2	20	9	....	....	....	..	......
37 Bedford	29.21	29.19	29.21	29.76	28.67	29.20	.	7	24	.	....	....	....	..	......
38 Somerset	27.76	29.76	27.76	28.10	27.30	27.76	6	2⅔	22⅓	6	2	9	....	..	2.076
39 Indiana	28.56	28.58	28.57	29.10	28.00	28.57	.	6	25	.	8	7	....	..	1.233
41 Warren	28.52	28.53	28.54	29.11	28.10	28.53	1⅔	3	26⅓	1⅔	....	....	....	..	......
42 Venango	28.91	28.91	28.95	29.53	28.45	28.92	1	4⅔	25⅓	1	3	2	....	..	2.017
45 Fayette	28.99	28.99	28.98	29.61	28.56	28.99	.	9	22	.		6	....	..	5.833
48 Alleghany	29.17	29.16	29.18	29.85	28.18	29.17	1⅓	5⅔	24⅓	1	8	2	3	..	3.935
49 Beaver	29.36	29.38	29.44	30.30	28.76	29.39	⅔	5⅔	24⅔	⅔	4	5	1	..	......
50 Butler	28.72	28.72	28.74	29.30	28.20	28.73	.	7	24	.	3	8	....	..	4.254

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
3 Bucks	1	⅓	9	⅓	.	⅓	⅔	⅓	⅓	.	6	1⅓	1⅓	2	6⅓	.	⅓	1⅓	....	.	.....	....	.	1395
6 Monroe	1⅓	.	2⅔	⅓	4	.	.	.	1	.	3⅔	1⅔	5⅔	⅓	2	.	.	8⅓	....	.	.....	....	.	1353
9 Susquehanna	5⅔	.	.	.	.	.	.	.	.	.	8	⅔	10	⅓	6⅔	.	.	.	....	.	.....	....	.	1403
11 Schuylkill	.	⅓	5⅓	2⅓	1⅓	1⅓	⅓	.	⅓	.	3	⅓	6⅓	2	3⅓	.	4⅓	⅓	....	.	.....	....	.	1362
12 Berks	⅓	.	1⅓	⅓	6	⅓	5⅔	.	.	.	4⅓	.	2⅔	1⅓	9⅓	.	.	.	....	.	.....	....	.	1350
13 Chester	2⅔	1⅓	5⅔	.	1	⅓	2	1⅓	⅓	⅔	3⅓	.	3	.	7⅓	2	.	.	....	.	.....	....	.	1344
14 Delaware	⅓	1	5⅔	1⅓	.	.	3⅔	.	⅓	1⅓	3	⅓	⅓	3	8⅔	1⅔	⅓	.	37.35	5	.....	....	.	1348
15 Lancaster	1⅔	⅔	4⅔	2⅓	1⅔	.	1⅓	⅔	1⅓	⅔	3⅔	1	4⅓	1⅓	3⅓	1⅔	.	⅔	25.45	1	......	32.63	1	1370
18 Dauphin	1⅓	.	3⅓	.	1⅓	.	12⅔	.	⅓	.	.	.	⅓	.	11⅓	.	.	⅓	....	.	.....	....	.	1345
19 Northumberland	3⅓	.	4⅔	.	2	.	2⅔	1	2	.	1⅓	.	7⅔	⅓	2⅓	.	4	.	....	.	.....	....	.	1343
26 Juniata	.	.	3	.	⅓	.	1	.	.	.	⅓	.	1⅔	.	5⅔	.	17⅓	1⅔	....	.	.....	....	.	1346
29 Adams	4⅓	1⅓	2⅔	.	⅔	.	1	.	2	1⅓	3	⅓	4⅔	⅔	1	.	3	.	18.50	7	.....	28.70	7	1375
31 Huntingdon	.	.	.	.	7⅓	.	.	.	.	.	.	.	22⅔	.	.	.	.	1	....	.	.....	....	.	1367
32 Centre	1	.	1⅓	.	.	.	.	⅓	.	.	⅔	.	4⅔	.	1	⅔	⅓	21	....	.	.....	....	.	1371
34 M'Kean	1	.	⅔	.	5⅓	.	4⅔	.	3	.	6	.	7	.	2⅓	.	.	1⅓	....	.	.....	....	.	1368
36 Cambria	.	.	.	.	3	.	5⅓	.	1⅓	⅓	3⅔	.	11	⅓	2⅓	.	1⅔	2	....	.	.....	....	.	1351
37 Bedford	.	.	.	.	.	.	3⅓	1	1	⅔	6	5	2	7⅔	4⅓	.	.	.	....	.	.....	....	.	1347
38 Somerset	⅓	.	.	.	.	.	2	.	1⅓	.	2⅔	⅓	8	1	.	.	9⅓	6	....	.	.....	....	.	1363
39 Indiana	.	.	.	.	.	.	.	.	2⅓	.	11⅔	.	8⅓	.	.	.	8⅔	.	....	.	.....	....	.	1354
41 Warren	2⅔	.	⅔	.	⅔	.	4⅔	.	4⅓	.	7⅓	.	5⅓	.	2	.	1⅔	1⅔	....	.	.....	....	.	1360
42 Venango	.	.	.	.	.	.	15	.	.	.	1⅓	.	.	.	13⅔	.	.	1	....	.	.....	....	.	1359
45 Fayette	.	.	1	.	.	.	6⅓	.	⅓	.	10	.	5⅓	.	5⅔	.	2⅓	.	....	.	.....	....	.	1442
48 Alleghany	.	.	2	⅔	1⅓	⅔	4	.	⅔	⅓	2	.	3⅔	1	4⅓	1	5⅔	3⅔	....	.	.....	....	.	1358
49 Beaver	⅓	.	⅓	.	.	.	5⅓	.	⅓	.	7⅔	.	.	.	14⅓	.	2	⅔	....	.	.....	....	.	1380
50 Butler	.	.	1	.	10⅓	.	1⅓	.	⅓	.	11⅔	.	5⅔	.	⅔	.	.	.	....	.	.....	....	.	1349

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Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notes on Belgium. By Captain G. W. Hughes, *United States Topographical Engineer. Addressed to* Francis Markoe, Jr., Esq., *Corresponding Secretary of the National Institution, Washington, D. C.*

Brussels, March 3, 1841.

Having been invited by the Superintendent of the National Foundry at Liege, to be present at the casting of some heavy pieces of ordnance, I left Brussels for that purpose, on the 12th of February, intending, if the weather should be favourable, to proceed, before my return, up the Rhine as far as Mayence, and on the Main to Frankfort, having in view an examination of the principal fortresses in Rhenish Prussia, and of the Free cities, especially the Castle of Ehrenbreitstein, and the other works in the vicinity of Coblenze, which constitute that city the military key to the Rhine and upper Germany.

A railway is open from Brussels to Liege, and the journey is performed in about five hours.

Stopped at Louvain over night, and started early next morning to see the lions of this ancient and curious town. The principal object of interest, and the just pride of Louvain, is the Hotel de Ville, which is regarded as the richest and most perfect specimen of the elaborate Gothic, out of Italy; and so far as ornament is concerned, is said to be inferior only to the Cathedral of Milan. Nothing can be more highly finished and ornate than this structure, for it is literally cover-

ed with carved figures and the minute tracery of fret work. The subject of many of the groups, is the punishment of the passions, which is often executed with more of force than of delicacy. This edifice has been recently perfectly restored, and now appears in the exact condition in which it was originally erected in 1493. It was built of a yellow sandstone, brought from France, in texture and colour resembling the fine grained varieties of the Potomac (Aquia,) free stone, but probably inferior to them in quality. It is certainly not a good material for carved work exposed to the atmosphere, as it disintegrates too readily. When the task of restoration began, there was scarcely a perfect figure or moulding on the façade. The same remarks apply with even more force to the celebrated *Dom Kirche*, of Cologne, which was originally built of sandstone, from the *Drachenfels*, containing a considerable proportion of *glassy felspar*. But for the taste and liberality of the King of Prussia, this magnificent Cathedral would, ere this, have been a mere heap of ruins. From time to time, considerable sums of money have been expended on its repairs; and hundreds of workmen are now employed on the completion of this structure, after its original plan, which, if ever carried strictly into execution, will not leave even St. Peter's without a rival. The King of Prussia has appropriated from his own funds, 1,000,000 of dollars towards this laudable object. The nave, on the completion of which they are at present mainly engaged, is 400 feet long, 161 wide, and 180 feet high, in the choir. The two principal towers, when finished, will be 500 feet high. Mr. Hope, in speaking of it, says, "its interior resembles a splendid vision," and its exterior strikes the beholder with "awe and astonishment." As the whole edifice is surrounded with scaffolds rising to the height of more than 200 feet, I was enabled to pass over every portion of the building, and to wander among the light and airy-flying buttresses, which relieve the walls from the enormous thrust and pressure of the immense arches of the choir. The upper portions of the work are made as light as possible, but are bonded together with copper and iron, and many of the stones are cemented with lead instead of mortar. The repairs are made of Trochyte, from the Drachenfels, which, after being laid, is saturated with oil. I have brought with me, specimens of the materials of this church, and of the Hotel de Ville, of Louvain; also of the red sandstone so much used for building purposes, at Frankfort and Mayence. They may serve as useful guides in avoiding similar errors in our own country; for it is truly lamentable to behold splendid structures, on which so much of genius, of labour, and of treasure, have been bestowed, crumbling so soon under the touch of time.

Beside the Hotel de Ville, I visited the Cathedral of Louvain, once

celebrated for its lofty and pointed spire of 533 feet in height, which was blown down in 1604; a stone model of which may be seen in the Hotel de Ville, which also contains many pictures, by the old masters, *before* the time of Rubens, curious only for their colouring, which is as vivid as the day they were painted, but the drawings are decidedly bad. But the boast of Louvain, in the way of pictures, is the gallery of M. Vanderschrick, containing some of the master-pieces of Rubens, Vandyck, Tenniers, Rembrandt, Wouvermans, &c. &c., which is most liberally thrown open to the inspection of strangers.

At one o'clock left for Liege, which was reached at four, P. M. The country between Louvain and Liege, is rolling—the soil rich, and in a high state of cultivation. It reminded me very much of the better part of the forest of Prince George county, and of the West river district of Anne Arundle, Maryland.

The railway is of a single track, and well constructed. It belongs exclusively to the government, and the police is placed under the sole management of the minister of public works, and is remarkably well regulated. The velocity of traveling is about twenty miles the hour, and accidents seldom happen. In the United States, we are unaccustomed to the interference of government in the management of public works; but certain it is, that nothing can be better regulated, *cheaper* and safer, than railway traveling in Belgium; whilst in England, where it is left to the control of incorporated companies, it is quite the reverse in all these particulars.* When a train is ready to start on a Belgian railway, a signal is given by the conductor at the head of the train, by sounding a bugle, and so soon as the signal is repeated, in like manner, from the rear, the engine is put in motion.

The railway does not enter the town of Liege, but stops, for the present, at Ans, three miles off. The descent from the station, to the valley of the Meuse, on which the new town is built, is very rapid. It is intended (and the work is rapidly advancing towards completion,) that this road shall be extended to the Prussian frontier, and thence by the way of Aix la Chapelle to Cologne—that portion of it connecting the two latter towns, will be opened for travel in a few months. When this shall have been completed, it will afford, at all seasons of the year, a direct communication with the Rhine, through either Antwerp or Ostend.

It is my intention, so soon as I can collect the necessary documents, to send you a condensed account of the Belgian railways; for it seems to me that many useful hints may be extracted from the system which

* Recent British publications show "the danger of loss of life on an average railroad trip, to be only one in 4,000,000.—Publisher.

has been adopted here with such signal success. In no other country, I am persuaded, has the great problem of reconciling adequate dividends, with cheap and safe traveling, and consulting, at the same time, public utility, been solved with so close an approximation to exact results.

13th of February—went this morning to visit the Royal Cannon Foundry, under the superintendence of Major Frederickx, of the artillery. These works are very extensive, and in fine order; they consist of two large foundries, of twelve reverberatory furnaces; of two large forge shops of fifteen fires; of one very large trip hammer; an enormous crane to hoist heavy pieces of ordnance from the pits in which they are cast—a furnace for heating large masses of iron, previous to re-hammering them—a large oven in which to dry the moulds—twelve boring and dressing machines, and five steam engines, only one of which is, however, usually employed.

A steam engine, of twenty-five horse power, performs the mechanical labour of the establishment. It was made by Cockerill, at Seraigne, and is a beautiful specimen of mechanism compared with the French engines formerly, and until recently, used for the same purpose. The engine room was very neat, and what was very characteristic of these people, every part of it not in use, was devoted to the culture of hot-house plants, protected by the heat of the engine, kept in constant action, from the inclemency of the weather. The machinery in the finishing room was very perfect, and in good condition. I here observed a machine for cutting and smoothing the trunnions of cannon which worked horizontally, and appeared to me much superior to the machine for the same purpose, with a vertical movement, in use with us. Major Frederickx informed me that he had sent a drawing of it to the United States Board of Ordnance, two officers of which visited this establishment last summer. The superintendent kindly showed me over these works, and explained every thing in relation to them with the greatest urbanity. The moulds for the cannon are composed of a mixture of five parts of silex, two of alumine, and one of coke. The sand and clay are sifted, and well ground together, the coke is minutely pulverized, and these substances are then intimately commingled, having been previously sprinkled with water. The moulds are formed of the required shape and size, by hard ramming in the cast iron pattern, and are then removed to ovens, in which they are well dried. The success of the casting depends on the fidelity with which this has been done. For hollow shot, the proportions are somewhat different, being five parts of sand, one of clay, and one of coke; but for large mortars, (*mortier monstre*, as they are called,) more clay is required than for ordinary guns. The clay is not of that

class of which fire bricks are made, but is very tenacious. This establishment is the first place where coke was used for moulds. In England, fine coal, in its natural state, is employed for that purpose, but it is not believed to be so good. There are no blast furnaces connected with this foundry, for the reduction of ores, and the metal is procured in pigs, mainly from the neighbourhood of Namur. Formerly, much of it was obtained from Seraigne, where, however, they now manufacture all the produce of their furnaces. They sometimes re-melt old iron with the pigs, in the ratio of two to three, for casting ordnance.

There is no one ore in Belgium that yields the requisite quality of metal for cannon, and several kinds are intermixed to produce the proper result. The character and proportion of these ores can be determined only after long practice and numerous experiments. Hence the advantage of a National Foundry, where experiments may be tried under the immediate direction, and at the expense, of government.

It requires a long personal experience to be able to judge with accuracy when the iron is just sufficiently carbonized, and is, in other respects, in that precise state to produce the best possible results. A rigid application, in this regard, of scientific principles, is impossible, and the proper information, on these points, can be imparted only by personal attention, for it depends so much on nice degrees of individual observation that it can be satisfactorily communicated in no other form.

It has been ascertained that the best gun metal is the produce of an ore containing a small proportion of calamine. The ores in general use are of several kinds, including the red and brown hematites, carbonates, limonites, and those peculiar to the coal measures.

This establishment is too large for the wants of the Belgian Government; in consequence of which they cast cannon for other nations; and the ordnance fabricated here is understood to be of a good character, both as to model and quality.

I here saw a colossal statue, in bronze, recently cast for the city of Antwerpt, of Peter Paul Rubens, the greatest of Flemish painters. It is after the design of Géefs—one of the most eminent of modern sculptors—and has been much admired. It is, however, a statue rather of the ambassador than of the great artist. Its height is nearly fifteen feet, English, and it weighs over 14,000 lbs.

In the course of the day I saw hollow shot, and a ten inch mortar, weighing about three tons, cast. The mould, encased in cylindrical cast iron frames, screwed together, and wedged tight, was placed vertically in a pit, and carefully sustained in its position by means of

wooden shores fitting into recesses in the walls. A good deal of gas was disengaged during the process of casting, at the joints of the frames, which burned with a blue lambent flame. It was probably carburetted hydrogen gas, formed by the decomposition of the very slight degree of moisture which had not been expelled from the mould, and the combustion of a small portion of the coke, one of the constituents of which the mould is made. It requires great care in drying the moulds before the metal is run into them, else the most frightful accidents may ensue, by the sudden generation and expansion of steam, carrying with it, and scattering in all directions, the melted metal. It was by neglecting the necessary precautions, in this respect, that the lamentable accident happened in the vicinity of London, by which the whole foundry was destroyed, and a large number of persons were killed or frightfully wounded. This led to the establishment of Woolwich, under the superintendence of a young German, by the name of Schwartz, (if I am not mistaken,) who, having discovered just before the casting took place, that the moulds were not sufficiently dry, reported this fact, and pointed out the fearful consequences that would probably ensue, to the proper authority; but in the pride of official opinion these representations were unheeded, and the result was most awful. No serious accidents have occurred at these works, owing to the many precautions which are taken to prevent them, when large castings are run; but with small pieces they are not so careful, and a few weeks before my visit an explosion took place in casting a small eprouvette, but no great injury was sustained.

The pigs and old scraps intended for ordnance, are melted in a reverberatory furnace with bituminous coal; and the metal is conducted from the furnace directly to the moulds. The quantity of iron put in the furnace is very nicely graduated to the size and weight of the required casting, so that a very small surplus of metal remains in the furnace, and this is run again into pigs for future use, or sometimes immediately into hollow shot. The large mortar used at the siege of Antwerp was cast at this foundry.

All the guns are cast solid, and then bored to the required calibre, the first boring being of the size of the chamber. Every piece of ordnance is proved with extremely heavy charges of powder and ball, but I did not observe any of the very nice machinery used at Woolwich, to ascertain if the boring of the guns, and the thickness of the metal corresponded with the specification, and if the line of collimation be precisely accurate. Shells are tested by pneumatic and hydraulic pressure. Eprouvettes, for testing the strength of powder, are made of cast iron instead of gun metal.

The same day visited the church of St. Jacques, celebrated for its

painted windows—the Citadel is a very strong work, and the Museum of Natural History, which contains an extensive and well arranged cabinet of minerals and geological rocks—among them a complete suite of the beautiful Belgian marbles, and a perfect collection of coal fossils, are particularly worthy of commendation.

The junction of the three valleys of the Meuse, Ousthe, and Vesdre, close to Liege, forms a landscape of no ordinary character.

16th February, at eight o'clock in the morning, left for Seraigne, having obtained permission from the proprietors to visit the extensive mines, iron works, and factories at that place. It is about five miles up the Meuse, from Liege, on the opposite side of the river. The ride up the valley of the Meuse is most beautiful—the valley is not wide, but the soil is extremely rich, and in the highest possible state of cultivation. It is indeed but a continual succession of villages, chateaus, and gardens.

The works at *Seraigne* occupy the palace and grounds of the last Prince Bishop of Liege. The palace is very large, and was formerly a most rich and beautiful edifice, but the present establishment is nearly three times its original size.

Nothing can afford a more striking illustration of the utilitarian spirit of the age than a visit to this ancient palace and modern work-shop; and in no other country, perhaps, can be found more signal instances of the mutability and shifts of fortune. This idea is beautifully expressed by Bulwer, in the following extract, which I have ventured to alter by changing a few words, to render it the more applicable to the present case. "You will find the kingly city dwindled into the humble town or the dreary village; exhibiting decay without its grandeur, change without the awe of its solitude. On the site on which Drusus raised his Roman power, and the Kings of the Franks their thrones, trade now dribbles in tobacco pipes, and transforms into an excellent manufactory the antique palace."

The machine shop is very extensive, being the largest of the kind I have ever seen, and is the greatest metallurgical establishment in Belgium. The wages paid to the operatives average about seventy-five cents per diem. It is estimated that from 40 to 50,000 lbs. of machinery is sent out, finished, every day, from this work-shop. The entire establishment, including rolling mills, furnaces, and mines, (worked within the walls,) gives occupation to about 3000 persons, nearly one-third of whom are females. The operatives are principally Belgic walloons, a very industrious, tractable race; in mechanical ingenuity but little, if at all, inferior to the British. But the machinery struck me as being, on the whole, not equal to the English; and in

many cases, I observed manual labour substituted for mechanical, but that was probably attributable to the cheapness of that kind of power in Belgium. There is an Englishman (the only one connected with these works,) in charge of the blast furnaces. He says his countrymen are soon spoiled when transplanted from their native soil, and become very worthless. To use his own language, "John Bull, like the Bull of Bashan, waxes fat, and kicks."

It is here many of the locomotives for the Belgian railways, and nearly all the machinery employed in the kingdom, are constructed. I saw, in different parts of the shop, wrought iron wheels for locomotives, in progress of construction. The wheel is composed of as many segments as there are spokes—each segment is forged with a short spoke projecting from it. This projection is welded to the corresponding portion of the spoke, previously fixed with lead in a cast iron hub; and the segments are successively welded to each other. To these segments is welded on the exterior a continuous well hammered iron rim and flanch, which forms the tire, so to speak, of this wrought iron wheel. After this welding, it is chilled to a proper temper.

In another part of the shop they were forging the immense shafts for the fixed engines intended for the two inclined planes at Ans, near Liege, by which the railway descends to the valleys of the Meuse and Vesdre.

The machinery of the inclined planes consists of two pairs of low pressure and condensing steam engines, fixed on the intermediate stage of the inclined planes, each being intended to move at pleasure the rope which passes from the superior to the inferior plane.

The cylinders of the steam engines are to be forty-nine inches (english) in diameter, and fifty inches long, (for the movement of the piston.)

Each pair of engines to possess a collective power equal to that of 160 horses; the horse power being estimated equal to the power required to raise over a simple pulley a weight of 150 lbs. three feet high in one second of time. The tension of the steam in the boilers is not to exceed the pressure of the atmosphere more than one-third of a kilogramme per the square centimetre, or of about eleven ounces to the square surface of four-tenths of an inch.

These engines are provided with six boilers, formed each of twelve interior tubes. Each set of boilers, (composed of three,) is to be able to generate sufficient steam for the two machines, and also, if necessary, for the small supplemental engine of ten horse power, which is intended to exhaust the cylinders of the large engines, and to supply the boilers with water by pumping from the river.

The cost of this machinery is as follows:

For the two steam engines, all the accessaries included,	380,000 fr.
For transporting and setting them up at the planes,	20,000
For the supplemental engine, and setting up,	11,300
For incidental charges of various kinds in fitting up the planes, furnishing reservoirs, &c. &c.,	20,600
	431,900 fr.

Equivalent to about $80,000 in round numbers.

All the axles for fixed and locomotive engines are formed of fagotted iron—that is iron of the best quality, first rolled into small rods, and firmly welded together, while red hot, by a ponder9us trip-hammer. It is in this way all parts of machinery liable to injury from sudden concussions—especially the axles of cars and locomotives, the breaking of which may involve such a fearful loss of human life—should invariably be fabricated; but the manufacturer too often substitutes chain cable iron (good as it is for most of purposes,) in its stead; which an engineer should never, knowingly, on any consideration, permit.

These works also supply the greater portion of the Belgic railway iron, which they were selling in large quantities while I was present, for the extension of the road from Liege to Aix la Chapelle, in Prussia. It is of the T form—weighs about forty-six lbs. per yard, and costs about $50 per ton, delivered at Liege. There is, however, considerable variation in the weight and prices of the rails for different sections. The chairs by which they are held weigh ten lbs., and the rails are fixed in them by wooden wedges. The old scoria is re-melted in a mixture of *half and half* with the natural ores, to produce rail road iron. After going through the usual processes of reduction, refining, puddling, &c. &c., they are twice rolled—then heated and rolled seven times in quick succession, before the rail is perfectly formed. It is probably owing to these numerous rollings that they are enabled to produce good rails, after using so large a proportion of scoria in the original reduction.

The rails on the Belgian roads are united at an angle of 45°, (forming a joint in my opinion equal to a square one.) The rail is not cut as in England, but after being heated, is placed in a *steel mould*, and then hammered down to the required angle.

The test of a railway bar is a weight of 860 lbs. falling on it from a height of 16½ feet. If the fibre be broken it is rejected. If it stands the test it is again rolled. To make the rails perfectly straight, they are brought under the pressure of a machine turned by a lever, and worked by manual labour.

There is a small steam engine in each shop, and in the rolling mills

one engine of 100 horses power, with an immense working beam. The aggregate power of the steam engines used in the establishment is equivalent to that of 800 horses.

The locomotives manufactured here are of five classes, the diameter of their cylinders being respectively 11, 12, 12½, 13, and 14 inches English, and costing from $7,000 to $8,000. A new engine which I saw at the work-shop, of 13 inches, cost 39,000 francs.

The large lion on top of the Waterloo monument, was cast at these works.

Connected with these works, are two blast furnaces in constant use. All the coals are coked, and yield about seventy per cent. No iron ores of much account are found with the coal, but overlaying the coal seams, some good ores have been worked in what is called the Anglier mine, yielding about sixty-five per cent. of excellent metal, well suited for ordnance, as it contains a small proportion of zinc. It has also some lead, but it is usually freed entirely from this latter substance, and forms a good deal of the former, as is shown by the white deposites on the chimney tops. This ore resembles, in other respects, the Lancashire ore, in appearance and quality. The most of the ores worked here are brought down the Meuse, from the vicinity of Namur—they resemble the Devon and Cornish ores, yielding about thirty-six per cent. of good metal. Some of them appear to be a species of ochreous or ferruginous clay.

The works at Seraigne were planned by Mr. David Muchet, (whose reputation as an iron master is well known,) for Mr. John Cockerill, an enterprizing Englishman. They seem to be very well arranged, and to answer perfectly the purposes for which they were designed. It would appear, however, that the furnaces had not formerly been well managed, as they are now re-melting the old scoria, which had been accumulating for years, from which they obtain over thirty per cent. of metal.

On the top of the stack of furnaces is placed a small engine, which draws the charge of ore, fuel, and flux, up an inclined plane. The hot blast is sometimes, but not often, used. Without it, about three tons of coal, and fifteen cwt. of limestone, are necessary to produce one ton of pig iron. With the hot blast, these items are much diminished, but the quality of the metal is deteriorated, owing, probably, to the development, by an extreme degree of heat, of the metalloids, or bases of the earths, which combine with the melted iron, and impair its quality. To a certain extent these extraneous substances may be expressed by rolling, but to expel them radically, must be a difficult undertaking.

The coal is worked at a depth of nearly 1200 feet, and is elevated

by machinery, as in England. There are, here, seven different seams, but several of them are too thin to be worked; the thickest is six feet. The coal is very similar to the ordinary Welsh coals, in appearance, and burns like them. These mines are liable to explosions from fire damp, and several persons had been killed a short time before my visit. After the accident, the proprietors ordered a large number of *Davy's Safety Lamps*, which I saw sent down the pit. I could not ascertain, clearly, whether they had used them before the accident took place, but am inclined to believe they did not.

Coal, through this region, is very abundant, in consequence of which manufactories of different kinds have sprung up on all sides. Formerly, Holland was supplied with coal from Belgium; but the home consumption, since the revolution, has increased beyond the supply of the Belgian mines, and a law has been passed, permitting the importation of coal from Great Britain.

Another large iron establishment is the property of a society in Brussels. It is next in size and importance to the works at Seraigne, and is calculated to employ 3000 workmen, whenever there may be a necessity for so large a force, which is not likely soon to occur. At present, there are not 300 persons connected with the establishment. Some of the locomotives for the Belgian railways are manufactured here. They obtain their refined iron from Austria, and pay about $35 per ton for it.

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Removal of Obstructions in the Mouth of the Mississippi. *By* A. C. Jones, *Engineer.*

Gentlemen:—Having seen in the newspapers several projects for deepening the water, or removing the bars at the passes of the Mississippi river, I am induced to give a sketch of what was done by the United States steam dredger Balize, as I am firmly convinced that the only feasible plan for improving the passes is by dredging. First removing all the lumps in the ship channel, and then deepening the bar by carrying it away as raised. It is idle to talk of daming, ploughing, or dragging, as these projects would never enter the brain of any person that was conversant with the difficulties to be encountered.

An impression exists that the bars consist of soft mud, and are easily removed. This is erroneous, for the bars are hard, and studded with mud lumps, which are forced by some subterranean agency through the bottom, and up sometimes as high as ten feet above the surface of the water. These lumps consists of a compact clay (alumine,) of the consistence of cheese, and the surface receives a fine

polish when cut with a sharp knife. The action of the water has very little effect on the lumps, (some have perpendicular sides,) except during severe storms, when the tops are washed off to the surface of the water. When the surface is slightly inclined, it is generally covered with innumerable clay pebbles, the fragments of the lumps taking that form by the action of the waves on them.

For a perfect understanding, I will give a short history of the Dredger from her commencement. The boat was built by John Vaughan, at Kensington, in a substantial manner, and the engine and dredge machinery, by Messrs. Levi Morris and Co.;* all being fair specimens of Philadelphia workmanship. The whole being under the immediate direction of Captain Andrew Talcott, United States corps of Engineers. The machinery for one side being so far completed as to make a partial trial in the dock; all bidding fair to perform well. The boat was hurried off in the early part of January, 1838, before the full completion of her machinery, through fear of being detained by ice. The Balize did not prove to be a good sea boat, owing to the peculiar distribution of the machinery on board, and in consequence of the roughness of the sea, caused considerable rolling; the boilers being cylindrical, and on the guards, at times, it was difficult to keep the water at the proper height. I found great benefit in knowing the level of the water, by the use of my gauge tube, as described in the Journal; the ordinary gauge cocks giving incorrect results, especially when foaming. The boat drawing nearly two feet more water than her proper draught, made the passage long.

I may mention here that I found the carbonate of lime in the boilers increase in quantity, in a given time, as we proceeded South, although the precaution of cleansing the boilers at the stopping places, and constant blowing, was strictly attended to during the voyage.

On the arrival of the boat at the North East pass, it, and all the force, was put in requisition to assist the corps of engineers in the survey which was then going on; and it was late in the season before all the necessary fixtures were completed to commence dredging. After several trials, it was found that the chain being part of cast iron, (although proved to a strain of twenty-seven tons, at Philadelphia,) frequently broke, owing to the hardness of the bottom, coupled with the great size of the buckets, the contents of each being one cubic yard. New chains were immediately ordered, but owing to shipwreck, and other causes, the chain for one side, although first made, did not arrive until eight months after. On the receipt of chains for

* As a proof of the excellence of the workmanship of the engine, I will give *one* example. When I left the boat, the key of the connecting rod, at the cross head end, remained as driven when steam was first applied to the engine, it not having been required to alter it.

one side, numerous experiments were tried at different parts of the bar, perfecting the machinery, and drilling the men. In November, orders were received to proceed with the dredger to Red river, to remove a bar at the mouth of the Chute—prior to our arrival, the pent up water had cut a channel of sufficient depth. The only obstacle was an island of mud, 140 feet long, and fifty feet at its greatest breadth; the whole being two feet above the surface of the water. The dredger was moored alongside, and operated on it with the buckets of one side, and in twenty-three working hours, one-half of the island was removed down to thirteen feet water. As the particles of mud were only carried away by the current, the same mud was raised by the buckets several times, and as many of them came up heaped, so as to contain two cubic yards, it was computed that the dredge raised the enormous quantity of 600 cubic yards per hour,* which is far surpassing any other machine in the world.

The Balize then removed back to her station, at the North East Pass, and proceeded to cut away a mud island, or lump, standing in the centre of the main channel, at the mouth of the Pass. The weather being stormy, the sea forced us to abandon the lump, after making several partial days work on it, and we then operated at the head of the bar proper, which extends five-eighths of a mile from the sea; this enabled us to work in smoother water. The bar being formed of alternate strata of sand and deposit from the river, making the bottom hard; and as the buckets were designed for soft mud, their size prevented their acting well—but with this disadvantage, 1500 cubic yards have been conveyed away by the hoppers, without extra exertions, in eight hours working.

On the 5th of March, we again moored alongside of the island which we previously worked on, and commenced working actively at it, when the sea would permit. The subduing it was necessarily a slow operation, its size being about 350 feet by 150, at its greatest breadth; the top being almost at the surface of the water, with nearly perpendicular sides. The dredge was a long time cutting at it with the buckets of one side before any mud could be raised by those of the other side, to be conveyed away by the hoppers.

On the 5th of April we had cut and removed nearly half of the lump down to thirteen feet water, the boat was then shifted to the north side of it, and on the 12th the dredger (drawing eight feet water)

* That there may be no doubt of this, I will state that eight buckets were raised per minute.

$8 \times 1 \times 60 = 480$ cubic yards, even measure. The buckets being kept heaped, 600 yards is a safe estimate.

passed over the top of the lump, operating with both sides and filling two hoppers at the same time.

On the 17th of April, 1839, orders were received to stop dredging and lay the fleet up, the appropriation being expended. A few thousand dollars more would have removed this lump from the channel, as the smoothness of the sea at this season of the year admitted of nearly constant working—subsequently the fleet was ordered to Mobile and there laid up.

The principal difficulties encountered in our operations were, 1st, in placing the machinery from the want of correct knowledge of the bottom—for although several partial surveys had been made by different persons from 1820 down, and inquiries from shipmasters and others supposed to be conversant with the actual state of the bars, yet their reports left the impression that the north east bar was soft mud and easily removed; as this proved to be incorrect the consequence was that numerous alterations had to be made as experience pointed out.

2d. The operations being on the margin of the Gulf of Mexico, great loss of time was experienced from the prevalence of easterly gales, which blowing against the current of the river caused considerable sea, the depth of cutting being from thirteen to fifteen feet, the force of the sea had a great effect in deranging the machinery.

3rd. In conveying the mud away from the dredger often considerable time was lost by the hoppers not discharging their load (one hundred cubic yards) owing to the mass becoming compact.

A great loss of working time was also owing to the tow boat frequently getting aground and blundering in bringing the receiving vessels to, and taking them from, the dredger, all these, coupled with the general inexperience attending works of this kind and magnitude, and being distant over one hundred miles from the nearest work shops, prevented a successful beginning; but the latter part of the operation, owing to the perfection arising from practice, was highly successful, and will bear a comparison with any other dredging operation.

In connexion with the foregoing, I give you the mean of a number of experiments made with the engine at Mobile, during the month of June, 1839, these may be relied on as correct although differing from some of the theoretical properties of expansion. I was unable to give higher speeds to the wheels on account of bringing home the anchors, the boat being moored in the stream.

The horizontal cylinder is nineteen and one-eighth inches in diameter, and seven feet stroke, and works either by a whole stroke eccentric or a five-eight cam, the exhaust either way being the whole stroke. Each wheel is of the double form, eighteen feet seven inches in diam-

eter; extreme length of the bucket six feet ten inches; each section has twelve buckets twenty-one inches deep.

The shaft has two fly wheels and couplings to admit of the engine being worked independent of the wheels.

The time for experimenting was chosen when there was little or no current, the engine being in perfect order, and working with little friction.

One pair of boilers were used, these being on the guard made the length of the steam pipe about thirteen feet, it and the cylinder being covered so as to lessen the radiation of heat. At the time of the experiments the boat had a list to port, which made the immersion of the starboard buckets two and a half inches, and the larboard ones seven inches. The pressure in the boilers being one and a half pounds to the square inch, the throttle valve being open (during the experiments,) and the whole stroke on, just kept the engine in motion, being equal to the friction.

Pressure in the boiler, lbs. per square inch.	Steam as applied.	Revolutions per minute.	Remarks.
6	Cam.	7.5	Engine alone.
6	Eccentric.	18.5	
5	Cam.	None.	
5	Eccentric.	12	
4.4	"	Just move.	Starboard wheel coupled.
6.4	"	"	Larboard.
10.4	"	"	Both wheels.
13.5	"	3.3	"
20.4	Cam.	Just move.	"
24.4	"	6	"
24.4	Eccentric.	9.5	"

I also verified the experiments noted in this journal, to prove that the water displaced by steamboat wheels did not come from before them, I strewed the surface of the water with chaff and then set the wheels in motion, and found that six inches in front of the wheels the chaff floated undisturbed.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Extracts from the Annual Report of the Board of Canal Commissioners of the State of New York. Dated Albany, January 25th, 1841.

The navigation of the canals was opened throughout all the lines on the 20th of April, and was closed on the 5th of December. Lake Erie was opened at Buffalo on the 27th of April.

During the thirteen years next preceding, the canals and the lake at Buffalo were respectively opened as follows:

In 1839,	the canals	April	20th,	the lake	April	11th.
1838,	do.	do.	12th,	do.	March	31st.
1837,	do.	do.	20th,	do.	May	16th.
1836,	do.	do.	25th,	do.	April	27th.
1835,	do.	do.	15th,	do.	May	8th.
1834,	do.	do.	17th,	do.	April	6th.
1833,	do.	do.	19th,	do.	do.	23rd.
1832,	do.	do.	25th,	do.	do.	27th.
1831,	do.	do.	16th,	do.	May	8th.
1830,	do.	do.	20th,	do.	April	6th.
1829,	do.	May	2nd,	do.	May	10th.
1828,	do.	March	27th,	do.	April	1st.
1827,	do.	do.	21st,	do.	do.	21st.

With the exception of a breach, which took place at Schenectady, on the 29th of April, and which was repaired on the 6th of May, and some other less important interruptions which are hereafter stated, no casualties have occurred to suspend the navigation.

The commissioners of the Canal Fund, in their recent report to the Legislature, (Assembly documents, 1841, No. 5,) state that the gross amount of tolls received during the season of navigation,

Were - - - -	$1,775,747.57
And in 1839 - - -	1,616,382.42
Increase $9\frac{3}{10}$ per cent.	$ 159,365.15

The amount which has been disbursed by the superintendents of repairs during the year ending January 1st, 1841, is $412,979.48. The movement of property upon the Erie canal has been unusually active, especially in the latter part of the season, and more than ordinary efforts have been made to expedite the passage of boats. The sudden increase of business which was experienced upon the coming in of the western crops, and the unequal manner in which the trade is necessarily distributed through the season, caused considerable delay and pressure at the locks. During portions of the season the boats were so much retarded, that in some instances, the length of their trips to and from tide water, was increased four days.

To relieve the pressure, by enabling the fowarders as far as practicable, to augment their cargoes, the greatest volume of water was admitted into the canal which its banks were able to sustain, and it may be affirmed that in this respect the capacity of the canal was pushed

to the utmost limit compatible with safety. The increased facilities which have been thus afforded to the navigation, are shown by returns which have been obtained from the weigh-masters in charge of the five weigh locks on the Erie canal, to wit, two on the tide water at Albany and West Troy, and three at Utica, Syracuse, and Rochester. The ascending trade of the canal, which consists mainly of merchandise, having been comparatively inactive, the movement from the tide water has considerably diminished. The returns from the weigh-masters at Albany and West Troy, (where nearly all the ascending cargoes are weighed,) show that the number at those two offices was,

In 1839,	6,739,	weighing	181,271 tons	—average	26.6 tons.
1840,	5,883,	"	155,113 "	"	26.3 "

On the other hand the number weighed at Utica, Syracuse, and Rochester, (consisting almost exclusively of descending cargoes,) was,

In 1839,	9,575,	weighing	326,806 tons	—average	34 tons.
1840,	9,625,	"	407,847 "	"	42.3 "
			81,041		8.3

showing an increase both in number and weight.

The greatest increase was at Rochester, where the cargoes,

In 1839,	were 3,974,	weighing	115,507 tons	—average	29.0 tons.
1840,	" 4,110,	"	171,869 "	"	41.8 "
	Increase - -		56,362 tons.		

The number of cargoes at Utica, Syracuse, and Rochester weighing upwards of 50 tons each, was,

In 1839 - - - - -	611
In 1840 - - - - -	1801

Of the cargoes at Rochester, 75 exceeded 55 tons; 7 exceeded 60, and there were two of 66½ tons.

The commissioners have deemed these inquiries important, for the purpose not only of ascertaining the maximum capacity of the present canal as a channel of transportation, but also of exhibiting the advantages which may be expected from augmenting its depth to seven feet. The results fully confirm the opinions heretofore entertained, that the canal, when enlarged, will admit boats carrying cargoes from 150 to 200 tons.

The augmentation above stated to have taken place during the last season, in the weight of cargoes, has correspondingly lessened the number of boats which otherwise would have passed the locks. Fur-

ther relief possibly might be obtained by adopting regulations which should prescribe the minimum weight of the cargoes and distribute the trade more equally through the season, but they probably would occasion considerable dissatisfaction, and could be justified only by extreme necessity.

An account has been kept for several years by the lock tender at Alexander's lock, near Schenectady, of the boats passing that point. For the purpose of obtaining information still more authentic, the commissioners have caused the clearances of all the boats which passed that lock during the last season to be enumerated, from which it appears that the true number was 26,987; being an average of 117 for each of the 229 days of navigation, or one in every twelve minutes. The irregular distribution of trade has, however, crowded into the months of May and October so great a proportion that the lockages in those months were,

In May	3,895,	being 125.6 daily,	or 1 in 11.5	minutes.
In October,	4,156,	" 134.0 "	or 1 in 10.8	"

And this rate has been itself increased by casualties, which have interrupted the navigation during those months. In May last the suspension amounted to six days; and in October to one day; leaving for the remaining twenty-five days in May 155.4 daily, or 1 in 9.26 minutes; and for the remaining thirty days in October 138.5 daily, or 1 in 10.39 minutes. Deducting the days of suspension for the whole season, and excluding April and December, the number of lockages was 25,854 in 204 days; being 126.7 daily, or 1 in 11.36 minutes.

It is stated that in the month of June, 1836, 246 boats were passed at Alexander's lock in twenty-four hours, being one in every six minutes; but it is not to be expected that the locks on other levels less favourably situated in respect to their supply of water, will be able to maintain so rapid a rate. At some of them, where the point of supply is remote, it may be doubted whether more than 200 boats can be passed in the twenty-four hours, or one in seven minutes. The difficulties arise not so much from the inability of the lock to pass the boats as from the scanty capacity of the channel of the canal, which does not enable it to pass the water required. This difficulty will be aggravated as the boats shall increase in number, for they will accumulate more frequently and in larger masses in the channel of the canal, and no relief whatever will be afforded by doubling the locks without enlarging the channel. The breach above mentioned as taking place in April last, occurred near Alexander's lock, but so much was the level obstructed by the crowd of boats that only seventy-six could be passed on the day the breach was repaired; 119 on the

second day, 152 on the third, and 210 on the fourth, having gradually increased as the crowd was dispersed. At the breach which took place on the long level at Frankfort, in May, 1839, a crowd of boats more than ten miles in length was accumulated; and it was ten days after the breach was repaired before the navigation could be entirely relieved.

It is impossible wholly to guard against interruptions in the use of a work so defective as the present canal. Breaches will inevitably occur, and it must be expected that as the number of boats shall increase, approaching nearer and nearer to the maximum capacity of the canal, every interruption to the navigation, however slight, will be more and more sensibly felt. It may be confidently predicted that when the average number of the lockages shall rise as high as 200 daily, the canal will be so much obstructed that a portion of the trade will be compelled to seek some other avenue to market.

The number of lockages is governed exclusively by the quantity of tonnage which descends, and is not affected by that which ascends the canal. The weight transported from the interior to the tide water, greatly exceeds that which is carried from the tide water into the interior, being in the proportion of at least four to one, so that the same boats which bring down the descending tonnage are able to transport the return cargoes. Being obliged to return and to pass through the locks, whether loaded or empty, the ascending boats do not increase the number of lockages; but each descending boat necessarily makes two lockages, one on its way down and the other on its return.

From this view of the subject, it will be obvious that the question of the time when the maximum capacity of the canal will be reached, does not depend upon the rate at which the revenue may increase; for much of that increase may, and probably will, be derived from the ascending trade; nor does it depend upon the rate of increase in the value of the commodities brought down. An accession to the descending tonnage of 100,000 tons of lumber or coal, paying in tolls but $ 60,000, will obstruct the navigation as effectually as the like quantity of flour or wheat, paying $ 300,000. On the other hand, 200,000 tons of merchandise might be added to the ascending tonnage and pay in toll $ 600,000 without obstructing the canal at all.

If the average weight of the descending cargoes be taken at 45 tons (and from the facts above stated that is rather above the true amount,) every 45,000 tons added to the present descending tonnage, will require 1000 boats, which will pass the locks once in descending and once in ascending, thus making 2000 lockages. If these should be distributed equally through the 228 days of navigation, they would produce a daily accession of $9\frac{8}{10}$ lockages; but if the 45,000 tons

should, and it doubtless would, be distributed like the rest of the trade unequally through the season, the daily accessions which it would produce in the crowded months of May and October, would be correspondingly increased, swelling the number from $9\frac{8}{10}$ to at least 11 daily. In the same proportion, an accession of 90,000 tons would increase the daily lockages to 22; 135,000 tons to 33; 180,000 to 44; and 225,000 tons to 55; which latter amount, added to the present daily average of 155 for October, carries the total beyond the maximum capacity of the canal.

The inquiry then is narrowed down to a single question; at what time is it probable that 225,000 tons will be added to the present descending tonnage of the Erie Canal? * * * * *

It will be obvious that no means exist for fixing with much precision the period when this quantity will be added, liable as it is to be affected by the ever varying vicissitudes to which the commerce of the country is exposed.

That the time may arrive very speedily is not impossible, and indeed not very improbable; while on the other hand, causes similar to those which in the last few years have affected the business of the canals, may again produce similar effects. * * * * *

Progress of Practical & Theoretical Mechanics & Chemistry.

On the Power of Anthracite Coal for generating Steam.

The number of the Edinburgh new Philosophical Journal for April, 1841, contains an article on the evaporative power of different kinds of coal, by Andrew Fyfe, M. D., F. R. S. E., President of the Society of Arts for Scotland; communicated by that Society. The whole of this interesting and valuable article is worthy of being re-printed in the Journal of the Franklin Institute, but, as want of space prevents this, the following extracts are inserted to show the conclusions to which Dr. Fyfe has arrived. It will be seen that, although the anthracite with which he experimented was of inferior quality, its evaporative power greatly exceeded that of good Scotch bituminous coal. The furnace was supplied with *heated air.* S. W. R.

The experiments, the results of which I am now to bring before the Society, were undertaken with the view of ascertaining the comparative evaporative power of different kinds of coal. Of course, in this investigation, my attention has been directed solely to the power of the fuels in raising steam, with the view of testing their comparative value for steam-engines.

If we suppose, as has been stated by Lardner and others, that it requires five and a half times as long to evaporate water that it does

to raise it from the freezing to the boiling point, then the latent heat will amount to 990. But others have made it lower than this. According to Despretz it is only 955.8. Assuming this as correct, then in steam the total number of degrees of temperature beyond 32 is (180×955.8) 1135.8—say 1136. Hence if one pound of carbon will raise 78.15 lb., as stated by Despretz, from 32 to 212, it will evaporate 12.3 lb. from 32—and this is the quantity fixed on by him.

It is well known that the different substances used as fuel consist, in their original state, chiefly of carbon and of hydrogen, in addition to which there is generally a minute quantity of oxygen and of nitrogen, and there is always a portion of earthy and metallic matter, constituting the ashes. The only one of these which, in addition to the carbon, will evolve heat during the combustion, is the hydrogen. Now one of hydrogen combines with eight of oxygen, or exactly three times as much as carbon requires. One pound of hydrogen will therefore evaporate 37 lb. of water from 32.

It is evident from this, that if we know the composition of the fuel, we can calculate the evaporative power by knowing the quantity of oxygen necessary for converting the carbon and hydrogen into carbonic acid and water. Of course, the greater the proportion of hydrogen, the greater ought the evaporative power to be. If the fuel contain nitrogen, a part of the hydrogen must be deducted from the whole quantity, because the nitrogen will unite with it to form ammonia; and, again, if oxygen exist in the fuel, the hydrogen which is requisite to convert that oxygen into water must also be deducted, and, accordingly, in addition to the carbon, it is only the hydrogen over and above what is required for uniting with the nitrogen and oxygen, that are to evolve heat by the combustion.

It is well known, however, that in burning fuel the combustion is rarely, if ever, perfect, and it never happens that the whole of the heat evolved is taken up by the water; as to the latter, there always is, indeed in the common way of consuming fuel there must be, a waste, which is necessary to keep up the draught; but in addition to this, much of the heat must also be lost by the ascending current of air, which in some furnaces is excessive, and of course the waste is enormous, frequently amounting to one-third, sometimes to one-half of that evolved. With regard to the imperfect combustion, much must depend on the nature of the fuel, and on the particular construction of the furnaces. Thus, when the fuel in common use is heated, it gives off gaseous inflammable matter, which, if it be brought in contact with air at the requisite temperature, will be inflamed; but if air be not present, or if there be a deficiency of it, then the greater part of the gas will escape without undergoing combustion, and hence the waste which, it may be said, occurs in every furnace constructed in the usual way. It has been supposed by some, that the combustion is perfect where there is no smoke, but this is by no means a proof that the whole of the inflammable is consumed; a part of the gaseous matter may be escaping in the state of hydro-carbon, or of carbonic oxide, without undergoing any action, and if so, it is just so much fuel wasted. It is evident then, that the *practical evaporative*

power must depend very much on the manner in which the combustion is effected, and also on the peculiar constitution of the coal; even when the combustion is as perfect as we can expect, still there may be a loss of heat from the generation of the gaseous materials; for when the carbon and hydrogen are evolved as hydro-carbons, they must absorb caloric to enable them to assume the gaseous form. Though we should naturally expect, therefore, that the heat evolved by those coals which contain much hydrogen should be greater than when little of it is present, this is not always the case; indeed we shall find that *the practical evaporative power is greatest when the fuel contains a great deal of fixed carbon;* for when the carbon is in that state, it must, before it can escape, combine with oxygen and thus be consumed, whereas, as already mentioned, the hydro-carbons may partly fly off without being burned.

From what has been said it is evident that the method proposed by Berthier is well adapted for ascertaining with ease the amount of heat that ought to be evolved by the combustion of a fuel; yet it does not indicate the available heat, in other words, what may be called the *evaporative power in practice.* The only method, I conceive, by which this can be done, is by actual combustion in properly constructed furnaces, and by measuring the quantity of water that is evaporated by the use of a given weight of the fuel, and we can then compare this with the quantity which carbon will evaporate, and which, as already stated, is, according to Despretz, 12.3 times its own weight from the temperature of thirty-two.

I am aware that to this method the objection may be urged, that as our furnaces are never so constructed as to effect complete combustion, and that as the combustion varies very much in different furnaces, the results ought not to be relied on. Now this is undoubtedly so far a valid objection; but if our trials are conducted with what will be allowed to be a furnace constructed on proper principles, and if the trials are made on the different fuels, making such adjustments and alterations as may be requisite for the fuel under use, then the results, though they do not give what ought to take place, yet give the comparative evaporative power in practice, and in this respect become extremely valuable, as pointing out the kind of fuel that is most beneficial for the purposes required.

With regard to the furnaces in which these trials were made, they were sometimes small, at other times and most frequently large, such as those attached to a four and ten-horse engine. In carrying on the experiments with one particular kind of fuel, I mean anthracite, it was necessary to have recourse to a peculiar construction of furnace, so as not only to secure the complete combustion of the coal, but also to try its power in raising steam rapidly, which, it is well known, is necessary when the fuel is to be used for steam-engine furnaces; and it is of the utmost consequence to keep this in view; for however great the evaporative power even in practice may be, that fuel is of little value if it cannot be burned so as to make it applicable for the purposes for which fuel is generally used, such as the rapid raising of steam, and keeping up a sufficient supply for the engine.

The experiments, the results of which I am first to detail, were made with the view of ascertaining the comparative practical evaporative power of anthracite and of Scotch coal. They were conducted with a furnace attached to a four-horse high-pressure boiler; the furnace bars, of which there were from twelve to fourteen, according to circumstances, were each three feet six inches in length, and in all two feet four inches in breadth, including the spaces between them, giving seven feet of fire surface. It was at first fitted up with flash-flues, which were afterwards changed to the common flue, eighteen inches by fourteen, passing along the boiler on one side, returning on the other, and then entering the chimney. The chimney-stalk was twenty-two inches by eighteen, and thirty-three feet in height, in addition to which an iron tube of a foot in diameter and twelve feet in height was attached, thus making the whole height forty-five feet. To this boiler and furnace there was attached an apparatus by which the fuel could, when required, be supplied with warm air. It consisted of a metallic box placed immediately beyond the end of the bars forming the floor of the furnace, from which there proceeded tubes that passed through the boiler, and so placed in it as to be surrounded by the water. From these, after passing through the front of the boiler, a large tube was transmitted to the ash-pit. A drain was carried from the side of the furnace to the box situated beyond the fire-bars to supply air, and the ash-pit was furnished with a door which fitted tight so as to prevent any current up through it. By this adjustment, when the ash-pit door was shut, the air for combustion was supplied through the box, heated to a considerable degree, and after passing through the tubes in the boiler, then proceeded to the ash-pit, and rushing up through the fuel kept up the combustion. By apertures left for the purpose and supplied with plugs, the temperature of the air passing into the ash-pit was ascertained.

The apparatus just described is that patented by Mr. Bell, with the view of increasing the heating surface exposed to the water in the boiler, and thus increasing the amount of evaporation. I do not, however, bring the experiments forward with the intention of proving the efficacy of this patent. It is not at all my intention to enter into its merits. I had recourse to this apparatus, merely as a means of enabling me to burn the anthracite, so as to make it subservient for the purpose of raising steam, and of keeping up the supply; and thus also to enable me to compare its practical evaporative power with that of bituminous coal.

Scotch Coal.—I conceive it unnecessary to give the result of the numerous trials made with this fuel. They, in general, come very near to each other. I give the particulars of one only, which was conducted with great care, and in the result of which the utmost confidence may be placed. The coal used was from Middlerig, and is considered of good quality.

In this trial the furnace was supplied with the cwt. of coal at three different stokings. The pressure on the boiler was seventeen pounds beyond the atmospheric pressure.

The table shows, that 784 lb. of fuel were used, and that 488 gal-

lons, that is 4880 lb. of water were evaporated from the temperature 45°, thus giving a result of 6.22 lb. for each pound of coal, at seventeen pounds pressure.

On subjecting the coal used in this trial to analysis, I found it to consist of—

Moisture, - - - -	7.5
Volatile matter, - - -	34.5
Fixed carbon, - - -	50.5
Ashes, - - - -	7.5
	100.0

By the test with litharge as proposed by Berthier, I found that the greatest quantity of oxygen required for the combustion of the fuel with which the first trial above given was made, was 205, which would make its evaporative power 9.48. But by the furnace trial only 6.22 were evaporated.

Now 9.48—6.22 = 3.26 and 9.48:3.26::100: 34.38; without taking into account the slight difference in temperature between 32° and 45°, there was therefore a loss of 34.38 per cent. of the heat supposed to be evolved, provided the whole of the fuel was consumed; but in this trial the cinders in the ash-pit amounted to fifty-two pounds, and deducting this from the fuel used, there were only 732 lb. actually consumed, which would make the evaporation amount to 6.66, and 9.48—6.66 = 2.82, and 9.48:2.82 :: 100: 28.97: thus giving a loss of 28.97 per cent. of the heat evolved, supposing 732 lb. of coal had undergone complete combustion.

Anthracite.—The anthracite coal with which my trials were made was much mixed, some parts being of good quality, others containing an admixture of impure coal, having a good deal of iron-pyrites and of earthy matter. In its composition it resembled the specimens analysed by Berthier. Its specific gravity varied from 1303.5 to 1406.6. To procure an average sample for analysis, a considerable quantity was taken from the heap at random, which was bruised, and from this a smaller quantity was removed and then reduced to powder. This, on analysis yielded

Moisture, - - - -	4.5
Volatile matter, - - -	13.3
Fixed carbon, - - -	71.4
Ashes, - - - -	10.8
	100.0

Anthracite of good quality burns with very little or no flame, and without smoke. When first thrown on the fire it decrepitates, and small pieces are thrown off from it, which choke up the spaces between the fire bars, and also the flues, and in a great measure prevent the combustion from going on. Though it can be burned in common grates, yet, unless consumed in some particular way, it does not answer well for raising steam, owing to the slowness of the combustion.

A patent was lately taken out by Mr. Player for effecting the consumption of anthracite, by previously heating the coal, by making the part of the apparatus containing the fuel to be supplied to the furnace, pass through the boiler, by which means it derives heat from the water. *The method I adopted was to supply the coal with air previously warmed*, which was done by making it traverse the apparatus already described, and by which the temperature was on an average about 350°. By this contrivance, the decrepitation was almost entirely prevented, the combustion was rapid, and the steam was easily kept up. I have already mentioned that the anthracite I employed was of inferior quality; it contained not only a large quantity of ash, but also of volatile matter, the latter of which made it burn with flame, while the former, owing to the intense heat generated, formed a tough slag, which adhered firmly to the bars, and in a great measure retarded the combustion.

It is unnecessary to state the result of the numerous trials made after having satisfied myself that I had effected completely the combustion of the fuel. I will confine my remarks to one only, performed when the furnace was in good working condition, the pressure on the boiler being seventeen pounds. It was continued from ten in the morning till half after six in the evening.

In this trial the total quantity of coal used was 448 lb., and the evaporation amounted to 3560 lb.; there were therefore evaporated 7.94 lbs. for each pound of coal. The evaporative power of this anthracite, when tried by the litharge test, was found to be 10.78, compared to that of carbon as 12.3.

Now $10.78 - 7.94 = 2.84$, and $10.78 : 2.84 :: 100 : 26.34$; there was therefore a loss of 26.34 per cent., supposing the whole of the coal thrown into the furnace was consumed. The coal found in the ash-pit was 40.5 lb., thus making the quantity actually consumed amount to 407.5, which would make the evaporation 8.73 for each pound of coal undergoing combustion. The evaporative power of this fuel, it has been already stated, as tried by the litharge test, was 10.78.

Now $10.78 - 8.73 = 2.05$, and $10.78 : 2.05 :: 100 : 19$; there was therefore a loss of 19 per cent. of the total heat evolved, supposing the $407\frac{1}{2}$ lb. fuel consumed to have undergone complete combustion. With the Scotch coal the loss amounted to 28.97 per cent.

On viewing the results of the experiments now detailed, one remarkable circumstance at once strikes us,—it is the great practical evaporative power of anthracite over the other kinds of coal, which, though they contain less fixed carbon, yet have much more volatile matter, the hydrogen of which, I have already said, gives out thrice as much heat as carbon does. In the anthracite which I employed, the fixed carbon amounted to 71.4 per cent., in the caking coal it was 67, and in the Scotch coal only 50.5. Now, with regard to the comparative practical evaporative power of the Scotch and English coal, I have stated them as 100 to 133, and as $50.5 : 67 :: 100 : 132$.

Again, with regard to the Scotch and anthracite, I have given the evaporative power as 6.66 to 8.73, and $50.5 : 71.4 :: 6.66 : 9.41$. *Thus, not only is the evaporative power in practice in the ratio of the*

fixed carbon, but there is a very remarkable approximation in the evaporative power to the proportion of this ingredient in each.

In the anthracite the volatile matter, independent of the moisture, was 13.3, in the English it was 29.5, and in the Scotch it amounted to no less than 34.5 per cent. We would therefore naturally expect that the English and Scotch coal would have a greater evaporative power, whereas that which has the least of these volatile ingredients has the greatest. It is evident from this, that, in the combustion of fuel in furnaces as commonly constructed, the loss of the heat evolved is occasioned in a great measure by the volatile matter; much of these we know is consumed, but even in the best constructed furnaces, there is an escape of a considerable proportion, owing to the want of a due supply of air, or from want of the proper temperature even though air is present; indeed it is chiefly owing to the latter, for we never find that the air that has passed up through the fuel is entirely deprived of its oxygen.

There is still another point to which I wish to advert. I have already alluded to the great practical evaporative power of those fuels containing much fixed carbon. On still farther viewing the results of the experiments which have been detailed, we find that not only does the evaporative power bear a ratio to the proportion of this element in the different fuels, but it would appear to be almost in the exact ratio of its quantity in each. Thus the fixed carbon in the anthracite I employed was 71.4 per cent.—now, taking that of pure carbon as 12.3

as $100 : 12.3 :: 71.4 : 8.77$,

the practical working of the fuel actually consumed was 8.73. The fixed carbon in the Scotch coal was 50.5 per cent. and

as $100 : 12.3 :: 50.5 : 6.21$,

the practical working was 6.66. In the anthracite used by Dr. Schafhaeutl, the fixed carbon was 92.42,

and as $100 : 12.3 :: 92.42 : 11.36$,

the practical working was 10.56. The evaporative power in practice seems therefore to be very nearly as the quantity of fixed carbon in the fuel. I am strongly inclined to think that this will be found to be the case with all fuels in their natural state; and if so, then in using fuel in furnaces as now constructed, supposing the combustion to be as perfect as we can expect to make it in these furnaces, we shall find the practical evaporative power to be according to the per-centage of fixed carbon.

Whether or not it is found that the practical evaporative power is as the fixed carbon, it must be allowed that in the trials, the results of which I have given, it bears a close approximation to it;—then a question arises, What becomes of the heat evolved by the combustion of the volatile ingredients? We know that the greater part of these is consumed, and they must give out heat by their combustion; if so, how does it happen that the evaporation is not greater than what should be occasioned by the consumption merely of the fixed carbon? This may, to a certain extent, be explained by the volatilization of the elements that assume the gaseous form. When heat is applied

to coal, by which it is made to unite with oxygen and itself give forth heat, a part of that heat must be spent in enabling the hydrogen, with the equivalent proportion of carbon, to assume the elastic form. Now, if the whole of this was to escape without undergoing combustion, while, at the same time, the fixed carbon only is burned, we can easily conceive that the evaporative power of a coal thus consumed, would be less than in the ratio of the fixed carbon it contains; but this is never the case in properly constructed furnaces; a great part of the gaseous matters is consumed, and they, by their combustion, again evolve the heat which was absorbed by them when assuming the elastic form. Perhaps in furnaces as now constructed, even on the best principles, the whole, or nearly the whole, of the heat thus disengaged is so required; of course, the greater the proportion of volatile matter, the greater will be the abstraction of heat while they become gaseous, and, consequently, it will require the consumption of a proportional part to supply the heat thus abstracted. While, therefore, the heat evolved by the combustion of the fixed carbon is a fixed quantity in each fuel, and as, when the gaseous matter evolved is great, a proportionally smaller quantity of it is generally consumed, hence the lower evaporative power of those fuels containing much of the elements that yield the volatile matter; and, again, as it is much easier to effect the complete combustion of fixed carbon than of all the ingredients, both fixed and volatile, of a bituminous coal, hence the value of those that contain much of the fixed element, when consumed in furnaces as now usually constructed. I know that what I now assert is at variance with the opinions entertained on this point by practical engineers, who generally think that a great deal depends on the flame of the volatile matter. If, however, any reliance is to be placed in the experiments the results of which I have detailed, I think they will be forced to allow that I am correct in what I assert: that the greater the proportion of fixed carbon in a fuel, the greater will be the practical evaporative power. In a national point of view, then, now that the demand for fuel has become so great, and that for long voyages it is of the utmost consequence to have the fuel powerful, so as to occupy as little space as possible, or rather, if I may be allowed the expression, to have a greater quantity of an evaporative power stowed away in the same space, it is of vast importance that attempts should be made to introduce the anthracite fuel.

Memoir on the Preservation of Timber. By M. A. Boucherie, M. D.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The development of industry in France, and the creation of new ways of communication, have considerably increased the consumption of timber in our country; on the other hand during twenty-five years of peace, the increase of the population has necessitated the giving to agriculture lands which were before occupied by forests.

Thus, whilst the employment of wood is increasing immeasurably, the production of it is every day more restrained, and the consequent

want of equilibrium must of necessity lead to an increasing elevation of the price, which is already attracting attention. In fact what are the bridges, canals, or railroads, already constructed, compared with those the necessity of which is daily proved to us? What is our merchant navy compared with those of England and the United States. The future then shows us the probability of the increased consumption of timber, and the probabilities of a supply are diminished by the perseverance with which our agricultural population continue to clear their lands: and yet France is even now unable to supply her own wants. The customs prove that of late the annual importation of foreign woods has exceeded the amount of thirty millions of francs, ($ 6,000,000.) These considerations, already of such importance, and so worthy of serious examination, assume additional interest when we consider the rapidity with which timber decays in use, and the extreme slowness of its reproduction.

Upon the sea, according to the documents of the English Admiralty, a ship lasts fourteen years in time of peace, and eight in time of war. On land, we know with what rapidity wood rots in low and damp places.

For some time, an insect, the thermites, has attracted particular attention on account of damage caused by them in constructions of wood. In the ports of Rochelle and Rochefort its propagation is so rapid that in a short time all the works which it attacks are destroyed. A member of the Academy, commissioned by the Minister of Commerce to examine these facts, admits that the importance of the ravages made by this insect has not been exaggerated ; and to cite an example, under ordinary circumstances, and one which may be easily verified, the timber employed in the construction of the galleries of the Jardin des Plantes, is already in parts worm-eaten, and the galleries are not yet finished.

Thus a very few years suffices to destroy wood, the formation of which has perhaps required more than a century.

By all these incontestable facts, is shown the necessity, every day more pressing, of arriving at the discovery of some mode of preserving timber, so as to establish an equilibrium between its production and consumption. In England they have occupied themselves seriously with this work, and numerous patents prove the efforts made to arrive at the results of which I speak, while the registers of the Admiralty prove the interest with which it has constantly regarded these researches, hitherto so fruitless. Some attempts made lately in France, have been attended with no better success.

All these efforts have, however, not been without use; in the solution of the great problem, they have prepared the way for more fortunate studies, and it is but just to give due credit to their authors; but I believe that I may be permitted to say that the question has not been completely solved, and that no one has as yet arrived at a result in all respects satisfactory.

In order to the more easy appreciation of my labours, I will briefly state the attempts made up to this time. These statistics of our former knowledge upon the subject, will allow us to judge more correctly

of the particular character of my studies, and to appreciate the peculiar importance of the results which I have obtained. The researches, which have had for their object the preservation of timber, may be divided into two general and very distinct classes:—

In the first, have been principally studied the best conditions of the season for cutting the wood, in order to preserve it; the most efficacious way of rapidly drying it, and the means of preserving it from alteration whilst drying. Hygeinic researches, (if I may call them so) have also been undertaken for the purpose of preserving wood used in constructions, and a proper system of ventilation is one of the means from which the best results have been obtained. We may cite, among other good effects, those which have been obtained from it on board of vessels, the durability of which is remarkably increased by it, as well as the health of the crew.

In the second class, are ranked the efforts which have been made to arrive at the discovery of different agents, the application of which to the surface of the woods, or their introduction more or less deep into its substance, might protect them from every species of alteration to which they are exposed.

It is not necessary that I should occupy myself with the first branch of these experiments, in which moreover, I believe results have been obtained as perfect as can be hoped for. I wish to recal only those results obtained either by the application of coats of different kinds, or by the penetration of certain chemical reagents, whose protective power has been considered infallible. The processes employed for coating or penetrating wood, have been but few, the reagents proposed have, on the other hand, been numerous.

Different coatings of fatty or resinous matters are the most ancient methods of preservation. The surface of the wood was covered with them to prevent the contact of the air, which is the most active agent of their destruction, whether as being indispensable to the fermentations which manifest themselves, or as the vehicle by means of which the germs of animals are transported into their substance.

These means of preservation, as may be easily conceived, and as experience proves, are of an essentially perishable character; the coating is gradually detached, and moreover it does not destroy the cause of internal fermentation; although employed from the most ancient times, these coatings have been in our own time the objects of new researches, but as the result has only been to change the substances employed without any positive advantage, it seems to me useless to recapitulate the different experiments which have been made in this way.

Very recently it has been proposed to coat with a coating of hydraulic lime; it seems that this method has given good results, but it is expensive. It is only within the last fifty years that chemical reagents have been proposed for the preservation of wood, and the number of these to which is attributed the power of preventing all decay is considerable. The following is an enumeration of them, extracted from a memoir by John Knowles, translated into French,

and inserted in the 12th volume of the Annales Maritimes et Coloniales, by order of the Minister of the Navy:—

Sulphate of Copper,	Carbonate of Soda,
" Iron,	" Potassa,
" Zinc,	" Baryta,
" Lime,	Sulphuric Acid,
" Magnesia,	Muriate of Soda,
" Baryta,	Quick Lime,
" Alumina and Potassa,	Nitrate of Potassa,
" Soda,	Arsenious Acid,

Deutochloride of Mercury (Corrosive Sublimate.)

Since the publication of Mr. Knowles' Essay, two other agents have been proposed and used, Oil and Kreosote. The slightest knowledge of chemistry will enable us to see that the greater number of these substances have been chosen by persons ignorant of their nature, and incapable of appreciating the reactions which they might produce upon the elements of the wood.

Thus, without speaking of insoluble bodies which are evidently useless, I will remark that all the sulphates proposed, except those of a soluble base, are decomposed by the wood, a part of the substance of which combines with their oxide, forming an insoluble compound, whilst the sulphuric acid, freed in the midst of the woody mass, acts upon it, as a corrosive, alters its nature rapidly, and causes it to pass into a substance much resembling carbon.

As to the sulphates with soluble bases, we can only conceive of their action by means of the changes which they effect in the liability to alteration of the sap, by mixing with it, and all known facts lead us to admit, that wood thus salted, especially with concentrated solutions, undergoes much more slowly those alterations which destroy it.

These remarks apply equally to the muriate of soda and the nitrate of potassa.

As to sulphuric acid and the carbonates of soda and potassa, it is difficult to conceive that they should have been proposed as preservative means. For it would be difficult to select more active agents of decomposition. The hopes to be entertained from the employment of arsenious acid and the deutochloride of mercury remain to be examined.

The property of volatility which the first of these bodies presents, forbids us to make use of it, even if we should be certain to prevent decay by means of it, a fact not yet ascertained, the accidents caused by its poisonous properties having forced them to abandon the experiments.

As to the corrosive sublimate, the preservative qualities of which have been justly celebrated, and upon which recent experiments made by Mr. Kyan in England, have again fixed attention; there is no doubt it is a preservative of great power, but the question of economy, which is inseparable from that of preservation, opposes imperatively the use of this substance, the price of corrosive sublimate, already very great, would be much raised by this new application, and would give to wood a price unfitting it for general use.

Moreover, the method always employed to introduce into the wood these different solutions, consisted in leaving them for a greater or less time, immersed in the solution, more or less dilute. In proceeding thus, we never attain more than an imperfect penetration, for it requires years to saturate heavy pieces of timber, with water alone.

Two new means for the preservation of timber have been proposed for public attention, since the publication of Mr. Knowles' memoir; the one is due to M. Breant, an officer of the mint, the other to M. Moll, a German mechanic.

The invention of M. Breant consists essentially of a very ingenious machine, which, acting by pressure, causes the liquid to penetrate through all parts of masses of timber of great diameter and length. A report of the Society for the Encouragement of National Industry has confirmed the good results obtained from this apparatus, and of its efficacy we cannot doubt. We may regard M. Breant therefore, as having solved the problem of penetration, as far as science is concerned, but the question of its practical application appears to me to remain untouched as to its principal point, that of economy. In fact in the employment of this means, we must consider not only the higher price of the machine, as a preliminary advance of capital, but also the great expense of maintaining it, and the inevitable repairs. It is hard to conceive that the price of timber would not thus become too great. The process of M. Moll is less known; it consists in introducing into the wood, kreosote in the state of vapour. I have not been able to procure any sufficient information on the subject of this invention, but I am disposed to believe, from the price of kreosote, that it does not solve the question of practical application.

Such was the state of our knowledge upon this subject when I commenced my study of it. Scarcely had the idea which is the foundation of my invention occurred to me, scarcely had a few experiments demonstrated its importance, when the circle of my observations immediately expanded.

Reflection caused me to forsee results of equally great importance with the preservation from wet and dry rot. Entering into the vast field of the arts which are affected by the employment of wood, I inquired of each manufacturer what was requisite in his especial department; while the preservation of the timber was necessary in all cases, sometimes it was necessary to give to certain kinds of wood a flexibility which they had not; in other cases the qualities of hardness, and immobility, and in almost all cases incombustibility were required.

Thus it was, that I embraced in my experiments a series of labours which I am about to submit to the Academy, and which have led me, I believe, to the discovery of efficacous processes.

1st. To protect wood against wet and dry rot.

2nd. To increase its hardness.

3rd. To preserve and develope its flexibility and elasticity.

4th. To render impossible, the play which it experiences, and the fractures consequent upon it, when, after being worked up, it is exposed to atmospheric variation.

5th. To reduce considerably its inflammability and combustibility.

6th. To give to it varied and permanent colors and odours.

Each of these important qualities which I have just mentioned, and upon which my experiments were directed, will be the subject of a chapter of this memoir.

It is only after two years devoted to this work that I presume to speak of it before the Academy. The new route which I have taken appears to me fertile in useful results. I do not pretend to have explored them all, and more skilful persons than myself will find in them matters for varied and important courses of experiments, but I have at least opened them up for their activity, and have traced the route for them. Perhaps, deeply impressed by the facts which I have observed, I may chance to hazard opinions little in harmony with those generally admitted. When truths come to light, they have to combat the errors which they are destined to replace, and if I have used a certain boldness in the exposition of my new ideas, it has not been done without an useful intention. Discussion brings light, and if I have committed errors they will justify themselves, as inseparable from that condition of novelty which marks the route in which I have traveled.

Moreover, it is not my intention at present, to speak of anything except the practical application of the results. Hereafter, if the Academy is kind enough to encourage this first communication, and thinks it worthy of interest, I will endeavour to unite in one work the materials which I have already collected; I will continue my efforts to complete them, as far as it is in my power to do so, and I will present myself again before them, as at present, to request their judgment and perhaps to merit their approbation.

[TO BE CONTINUED.]

Report made by M. PAYEN, *in the name of a special committee, on* M. BREANT's *method for the Preservation of Wood.*

[Translated for the Journal of the Franklin Institute.]

This process, (which dates from 1831) consists in impregnating wood with different solutions, by immersing the pieces in cylinders filled with the solution, and bringing a heavy pressure to bear upon the liquid.

The penetration is so perfect that even oily liquids reach the interior of the vegetable cells. Thus, in this regard, the efficacy of the process is evident; it is probable that the exceedingly condensed parts, such as the knots and heart of certain woods, which resist absorption by this means, will not be reached by any other process.

On the other hand it may be conceived, that the portions of the wood which have been rendered porous by decay, are easily filled with the solutions which are intended to preserve them from further injury. This may be judged of from a specimen in which the rotting has been arrested ever since 1834. In reference to the economy of the process, we shall soon be capable of judging, M. Breant having promised to place at our disposal the cast-iron cylinder and forcing pump, which he has used in his experiments.

It may be applied to causing the penetration of wood by oily and resinous solutions, which have not, to our knowledge, been used by the authors of the other processes.

But the first and most important condition which must be satisfied by the process, is to furnish pieces of wood which should resist decomposition, under circumstances in which the original wood would be injured. In reference to this point a decisive experiment has been made and recorded.

Deal plank, two inches in thickness, some of which were impregnated with flaxseed oil, and others left in their natural state, were placed at the same time upon the bridge Louis Philippe in 1834.

At the present time, that portion of the flooring of the bridge which was of ordinary wood has been so far decayed as to require entire renewal. The parts formed of the wood prepared by oil are hard, sonorous, free from all alteration, and seem to be in the same state as when laid, six years ago. This may be judged of, by remarking the perfect tightness of the nails driven into the wood. Two of these planks prepared by oil have been taken from the bridge and preserved by us, the others remain for the purpose of making future observations.

Bulletin de la Societé, Jan. 1841.

On an unoxydizable Metal for Castings, or White Brass. By M. Sorel.

[Translated for the Journal of the Franklin Institute.]

This alloy has the fracture and aspect of ordinary zinc, but possesses remarkable properties which will render it valuable in the arts. It is as hard as copper or iron; it possesses more tenacity than soft brass castings; it may be turned, filed, or bored, as well as those metals; it does not adhere to the metallic moulds in which it is run, and may be kept in moist air without rusting, or in the least losing its metallic lustre. Such an alloy will be of great utility in the manufacture of machinery, and as, moreover, it takes with great facility any of the bronze colours which it may be desired to give it, either by covering it with metallic precipitates, or by developing the copper which it contains, it will be eminently suitable to be employed in casting statues, vases, and other objects designed to ornament public monuments exposed in the open air. It will have, moreover, the advantage over bronze, of costing less.

It is prepared by casting together with proper precautions, zinc, copper, and cast-iron. It contains 10 p. ct. of copper, and 10 p. ct. of iron.

(Annales des Mines—Mai—June, 1840.)

Abstract of a Lecture on the Continental Method of Assaying Copper Ores. By Mr. S. H. Thomas, *formerly of Gwennap, but recently of the Alten Mines, Norway.*

The Swedish and Norwegian method of assaying copper ore, as employed at the School of Mines at Fahleen, is in the humid way,

with sulphuric acid; it has been adopted in Germany, and lately introduced into some parts of England, and is performed in the following manner:—

The ore, after being thoroughly dried, is first pounded in an iron mortar, and afterwards reduced to an almost impalpable powder in a calcedony or agate mortar, and, after being well mixed, 100 grains are to be weighed and carefully placed in a digesting flask, with a short wide neck; about three-quarters of an ounce of concentrated sulphuric acid is next to be poured on the ore, and the whole digested on a sand bath, with a heat sufficient to boil the acid, and continued till all vapours from the acid disappear, and the mass becomes dry. Should any of the ore remain undigested, which may be easily distinguished in the bottom of the flask, a small quantity of the pure acid must again be added, and the process conducted as before. From twelve to twenty-four hours are necessary to evaporate the assay to perfect dryness; this, however, will depend upon the quantity of acid used, for if in excess the evaporation will be completed with great difficulty. Care must also be taken to keep up the fire throughout the process, and more particularly so at the close, for, in case it diminishes, the highly concentrated acid, from its great affinity for water, will absorb humidity so rapidly from the atmosphere, that in a short time the bulk of the solution will be almost equal to the acid at first introduced, and nearly as much time will be required for its evaporation to perfect dryness.

When the ore has been perfectly digested, and forms a dry mass, fifteen or twenty drops of acid are added, and, after being again digested for about half an hour, the whole is to be washed out in pure hot water, and afterwards rinsed on an evaporating dish. While the solution is hot, it is filtered into a large precipitating glass, made of equal thickness throughout to enable it the better to withstand the heat; the residue on the filter is to be washed with hot water until the droppings cease to change the colour of litmus paper; the solution in the glass should be perfectly transparent, of a greenish, bluish, or deep greenish-blue colour, according to the richness of the ore.

The glass containing the filtered solution is next placed on a sand bath in a moderate heat, and a small square bar of polished iron inserted, when an escape of hydrogen gas will immediately take place, and the copper will be precipitated in a metallic state. When the solution has become quite colourless, and the precipitation completed, the liquor is to be decanted, and the precipitate washed in clean hot water, slightly acidulated with sulphuric acid, by which any particles of sulphate of iron which might have been precipitated with the copper may be separated. The copper is next collected on a filter, the weight of which has been previously determined; it is then dried and weighed as quickly as possible, and the weight of the filter being deducted from the weight of the paper and copper, will leave the per centage of copper contained in the ore. A silver evaporating dish is recommended in preference to the filter, as the copper in this manner may be evaporated to dryness in a much shorter time than could be done with a filter, and it is not so subject to oxidation.

The following method of collecting and refining the copper, as practised at the School of Mines at Freyberg, in Saxony, will be found to differ very materially in almost all the processes, from the foregoing, and also from anything at present employed in England. Mr. Thomas believes the docimastic assay is pretty general throughout Germany, but the humid assay is frequently used and recommended in preference to any other.

The construction of the furnace employed at Freyberg differs from that of our common air furnace; it is made in precisely the same manner as our muffle furnace for the cupellation of silver. A muffle is placed in the centre of the furnace, and the heat is regulated by dampers and doors fixed in the different parts of the fire-place and ash-pit. The calcining crucible is formed in the shape of a cupel or test, made very flat, of a very pure kind of fire-clay, and with a shallow concavity on the upper part for the reception of the ore.

One hundred grains of pulverized ore are to be mixed with an equal bulk of charcoal powder, and placed in the shallow calcining crucible in the muffle; the heat of the furnace is gradually increased until all sulphurous or other fumes cease to rise, but not to such a degree as to fuse the ore, or make it stick to the bottom of the crucible. When all vapours have apparently ceased to be emitted, the crucible is removed from the muffle, and the assay carefully turned in such a manner, that, by replacing it, that part which before was undermost shall now be upwards, and exposed to the action of the atmospherical current of air passing through the muffle. When the ore has been sufficiently roasted on both sides, the crucible is again removed from the fire, and, when almost cold, the ore is to be mixed a second time with charcoal powder, in an agate or calcedony mortar; it is again subjected to the same process of calcination as before, and at its close the fire is increased to a strong red heat, to ensure the reduction of all sulphates, and the absence of the sulphurets, either of which being present in the after processes, would render the result inaccurate.

When the calcination is complete, and the assay rendered free from all volatile matter, it is taken from the fire and allowed to cool, and afterwards mixed with about thrice its weight of black flux, and 10 per cent. of granulated assay lead, and afterwards fused in a covered crucible in a strong white heat. The lead, from its affinity for copper, readily combines with the small particles of revived metal diffused in the slag, and, from its greater fusibility and specific gravity, easily subsides and separates from the earthy matter and other impurities. When the assay is sufficiently melted, and after being allowed to cool, on breaking the crucible the button of lead and copper will be found at the bottom.

During the time the assay is melting in the air furnace, a cupel or test, made of very fine and pure fire-clay, of a smaller size and less concavity than the calcining crucible, is placed in the muffle and subjected to a full white heat, after which the alloy of lead and copper is placed on it and tested in precisely the same manner as a silver assay. This process, however, requires much care and address, for

the instant the lead is completely oxidized and separated from the copper, the cupel is to be removed, and together with its contents, immersed in a basin of cold water ready at hand for that purpose. The sudden cooling prevents the lead from acting on and dissolving any part of the copper. In this manner, after considerable practice, very small portions of copper may be extracted from the ores, and it is on the same principle that the assay with the blowpipe is conducted, the only difference being in the separation of the lead from the copper by boracic acid.

To ensure an accurate result with the blowpipe, it was necessary that the substance should be eight or ten times as much as the assay; it should be reduced to an almost impalpable powder in an agate or calcedony mortar, and well dried previous to weighing. Care must be taken at the same time that the heat be not sufficient to calcine the ore or drive off the volatile substances, such as sulphur, arsenic, &c.; it should never be raised higher than that required to evaporate the aqueous particles. The assay of copper with the blowpipe is divided into two classes, viz:—Such as have the component parts volatile, or in which the copper in the state of an oxide is vitrified, or otherwise combined with earthy matter; and metallic combinations in which copper forms the principal, or only a small part of the whole. To the first belong the greater part of the ores of copper, and minerals containing this metal, and also the products of smelting-houses; and to the second metallic alloys, of all kinds, in which copper forms a component part.

As all substances ranked under the first class require roasting or calcining, 100 milligrammes (about one and a half grain,) must be placed in an agate mortar, and carefully mixed with three times its volume of pulverized pure charcoal, or with twenty milligrammes or twenty-five milligrammes of graphite—the latter, in most cases, being better for arsenical ores. This mixture is next placed in a shallow calcining crucible, prepared on the inside with red chalk, and the crucible is supported in a large deep hole, bored for the purpose in the charcoal, by the platinum wire and foil belonging to the blowpipe furnace or charcoal holder. For the purpose of calcination, a jet of large aperture is used with the blowpipe, and a strong oxidating flame is directed to that part of the charcoal immediately under the platinum support on which the crucible containing the ore is placed; care, however, must be taken that the heat be not sufficient to melt the ore. When the sample has been subjected to the calcination for some time, and the charcoal is burnt away from the upper part, it forms a hardish mass. The crucible is taken from the support, and with the assistance of a small spatula, the ore is turned over so that the bottom part may also be exposed to the air. To ensure the absence of arsenic and sulphur it is again mixed with charcoal dust and exposed to a strong red heat, after which it may be considered as perfectly calcined. The calcined ore being now composed of the oxide of copper, with other metallic oxides and earthy matter, it is to be mixed with 100 milligrammes of soda, and fifty milligrammes of borax glass. The soda is employed for reducing the oxide of copper,

and other metallic oxides easily reduced, and the borax glass for dissolving the difficultly reducible oxides, such as iron, manganese, and cobalt, as well as the earthy matter. The ore, after being well mixed with the flux, is inclosed in soda paper, and melted in a small hole made for that purpose in a piece of well burnt charcoal in the reducing flame, until all the copper is collected in a bead, and the other oxides, together with the earthy matter, form a fusible slag. If on breaking the slag the copper be found of a grey colour, it is a proof that the calcination was not perfect, and in this case it will be necessary to re-melt it with fifty milligrammes of granulated assay lead, and a little borax and soda mixed together, in a small hole on the charcoal with the reducing flame, until the copper combines with the lead and the soda, and the borax forms a clear glass bead. When this substance is sufficiently melted and cooled, the cupreous lead is to be separated from the slag and treated in the same manner as a metallic alloy.

In all combinations of copper with earths, such as silicates, and many other varieties, and when the copper averages about 30 per cent., it is necessary to add about fifty milligrammes of lead to the other fluxes; the lead combines with the copper, and prevents any mechanical loss that might otherwise occur in the slag. Fifteen or twenty milligrammes of oxide of antimony may be used instead of the lead; this metal reduces with the copper, and may afterwards be easily sublimed, leaving the copper pure. Metallic combinations, in which copper is a component part, is one of the most complicated of copper assays. It has been found that copper is easily separated from lead by melting the combination with boracic acid on charcoal—the lead is oxidized and dissolved, and the copper remains pure. Should a small portion of the copper be oxidized, and also be dissolved by the acid, it may again be easily reduced. If the copper or lead contain a small quantity of oxidizable metals, they are separated with the lead. On this account all combinations of lead and copper, with small portions of other easily oxidizable metals, are easily and accurately assayed by the blowpipe with boracic acid. Alloys of copper and antimony, or copper and tin, must be treated in a different manner.

An alloy of copper and lead is thus separated:—About an equal weight of boracic acid must first be melted to a bead alone, on the charcoal, the assay is afterwards added, and covered with a good reducing flame. Should the boracic acid become very fusible, and cover the metal, the blowpipe must be inserted deeper in the flame, and a fine blue point brought to act on the globule, so that the metal may be kept on the surface of the acid, in conjunction with the charcoal; one part will thus be acted on with the acid, and the other by the coal. By this means the lead shortly oxidizes through the action of atmospheric air, and is dissolved by the acid, leaving the copper pure. This process must be continued uninterruptedly until the lead is completely oxidized and the copper refined, which will be perceived from the greenish-blue colour it assumes when melting; the moment this change is observed, the flame is to be directed to the glass, by which the oxide of lead is slowly separated. When the

bead of copper has assumed a peculiar greenish-blue colour, the heat is discontinued, and the copper removed from the slag with the pincers, and when cold its properties may be investigated.

Of all the different modes of assaying copper ore with which the lecturer was acquainted, excepting that in the humid way with sulphuric acid, he must certainly give the preference to that at present used in Cornwall, which, although still very imperfect, is the most expeditious, and more to be depended on than either of the others. The German assay with lead comes next, but this requires both a practised eye and considerable address, to detect when the copper is sufficiently fine and the lead perfectly oxidized, without dissolving any of the copper. The French assay, as well as many of those employed in other parts of England, must necessarily be imperfect, for the great portion of earthy matter and metallic oxides in combination with the calcined ore, must render the slag thick or pasty, and the copper can only be reduced in part and collected, the remainder being dispersed throughout as well as in combination with the slag. The great advantage the Cornish assay possesses over the others consists in the first process of concentrating the copper, or, as it is termed, in making the regulus. All the earthy matter, and most of the metallic oxides, are in this process separated from the copper, which, combining with a portion of the sulphur, is obtained in an almost pure state, being alloyed only with a small quantity of iron, which is easily separated in the subsequent processes. The humid assay with sulphuric acid is the most correct, but the process is long and tedious; it requires a great deal of care and attention, and much skill and practice are necessary to ensure an accurate result. In precipitating the copper from its solution with an iron bar, without great care, a precipitate of sulphate of iron will also fall with the copper, which can only be properly separated by washing with dilute sulphuric acid; but in doing this great caution is necessary to prevent any loss of copper that might otherwise occur with the iron. In drying the copper the operation must be performed quickly, and the dry precipitate weighed immediately afterwards, otherwise the copper will be subject to oxidation, and, consequently, the result obtained will show a greater per centage than the actual produce of the ore.

The best method of obtaining copper from any of its ores, that Mr. Thomas had found, is that employed in an analysis for separating the copper in solutions of copper and iron, with a current of sulphuretted hydrogen gas. The following process he elucidated with experiments on solutions of copper, which he had prepared for the occasion. The ore, after being reduced to an almost impalpable powder, if not completely decomposed by nitric acid, is to be deflagrated, with three times its weight of nitre, in a red-hot crucible; the alkali is separated by washing with boiling water, and by treating the residue with muriatic acid nothing but the silex will remain, which must be separated by filtration. The solution is next to be evaporated to dryness and re-dissolved in distilled water, when all the soluble salts will be taken up, and the insoluble parts will remain in the form of a fine gritty powder, which must be separated as before. The solution

should now be of a fine transparent green, or greenish-blue colour, according to the richness of the ore, and it should not contain any excess of acid by which the tests or re-agents would be decomposed, or their action on the copper prevented. A current of sulphuretted hydrogen gas, prepared from the protosulphuret of iron and sulphuric acid, is next passed through the solution, when the copper will be precipitated in black flocks, which is the bisulphuret of copper. To prevent the noxious vapours which invariably arise from the escape of the gas while passing through the solution, the lecturer precipitated the copper by the addition of some pure water saturated with the gas. As this gas has no effect on solutions of iron together with the earths and some other metallic oxides, the copper will be precipitated alone. After the solution has been perfectly saturated with the gas, it is to be filtered, and the residue washed in water impregnated with the gas—the bisulphuret of copper will thus be obtained pure. The filter is next to be dried and burnt, and the residue digested in dilute nitric acid—the solution must be evaporated to dryness and again dissolved in distilled water, and, when filtered, the whole of the sulphur will remain, and the copper once more be in solution; pure potash, or soda, is next to be added, when the copper will be separated in the form of a bulky blue precipitate, which is the hydrated black oxide. When this precipitate is boiled with an excess of potash it becomes black and quickly subsides; but if the quantity of potash be insufficient to decompose the salt completely, the precipitate is green, being a sub-salt of copper. The black precipitate, when dried and ignited, may be calculated at 80 per cent. of pure copper, or may be reduced to the metallic state in a crucible lined with charcoal, after being mixed with carbonate of soda and charcoal dust.

Physical Science.

Action of Great Fires Preventing the Formation of Storms. By M. Mattenci.

M. Mattenci had noticed the custom recently established in a parish in Romagna, of kindling great fires with this view, and remarked that during three years that this practice had been followed, the parish, previously ravished every summer by hail, had been spared, while the neighbouring parishes had not been. M. Arago thought that more legitimate conclusions might be drawn from observations made in countries where a great number of high furnaces and smelting houses are met with, as in certain parts of England; but the presence of metallic veins is a complication which necessarily interferes with the results observed. M. Mattenci, on this occasion, pointed out a locality in which the influence of metallic veins does not complicate that of the great fires. In traveling in the Apennines, he found that the cantons in which charcoal and sulphur were manufactured, never suffer by hail.

Chemist, vol. 1, page 49.

Meteorological Journal for 1840, *kept at the Lancaster Conservatory of Arts & Sciences, Lancaster, Pa., by* Washington L. Atlee, M. D., *Obs.*

		Barometer.			Thermometer.					Hygr'm'tr, 2 p m.			Sky.				Winds.				Clouds.			Rain.
		7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	Reg'r.	Mean.	Dew point.	diff. bet. dew pt. & temp.	Wet bulb.		7 a.m Days	2 p.m Days	9 p.m Days		7 a.m Days	2 p.m Days	9 p.m Days	7 a Days	2 p.m Days	9 p.m Days	Rain Gauge Inches
January.	Average.	29.50	29.46	29.50	20.19	30.10	22.66	18.05	24.05	19.72	9.58	27.98					N.	0	1	1	0	2	0	
																	N. W.	9	10	9	5	6	1	
	Maximum.	29.98	29.95	29.95	43.	48.50	36.50	34.	41.25	48.50	25.75	48.50	Ent.clr	6	7	15	N. E.	5	3	4	1	1	0	
																	S.	0	0	0	0	0	0	
	Minimum.	28.78	28.75	29.07	–1.	11.	5.	–1.	7.50	.70	0.00	10.	Ent.cld	1	8	14	S. W.	5	7	5	1	2	0	
																	S. E.	6	2	7	0	0	0	
	Range.	1.20	1.20	.88	44.	37.50	31.50	35.	33.75	47.80	25.75	38.	Prt. clr	14	16	2	W.	6	7	5	9	9	0	
																	E.	0	1	0	0	0	0	
	Omitted.									1 day	1 day	1 day									9	5	15	2.6[illegible]7
February.	Average.	29.62	29.58	29.59	33.57	46.57	35.28	30.86	38.68	36.15	9.17	36.67					N.	3	1	0	1	2	0	
																	N. W.	7	8	8	3	2	1	
	Maximum.	29.96	29.89	29.89	55.	69.50	58.	52.50	61.	58.38	20.19	62.	Ent. clr	7	6	10	N. E.	4	4	4	0	1	0	
																	S.	1	4	4	1	0	0	
	Minimum.	28.94	28.87	29.08	–2.	18.50	6.	–2.	10.25	11.24	0.00	18.	Ent.cld	13	10	15	S. W.	4	6	6	4	5	0	
																	S. E.	6	1	4	0	0	0	
	Range.	1.02	1.02	.81	57.	51.	52.	54.50	50.75	47.14	20.19	44.	Prt. clr	9	13	3	W.	1	2	1	7	7	1	
																	E.	3	3	1	0	0	0	
	Omitted.			1 day			1 day			2 da's	2 da's	2 da's				1				1	7	6	17	2.430
March.	Average,	29.31	29.27	29.34	39.33	54.61	43.07	36.29	45.54	38.01	17.90	47.67					N.	3	1	2	1	0	0	
																	N. W.	5	8	10	2	2	0	
	Maximum.	29.83	29.76	29.72	59.	75.	64.50	53.	63.25	60.	29.43	63.	Ent. clr	5	4	13	N. E.	2	1	5	0	0	0	
																	S.	1	0	1	2	0	0	
	Minimum.	28.84	28.81	28.94	20.50	32.50	24.	19.	25.75	22.73	0.00	30.	Ent.cld	11	5	7	S. W.	9	7	4	1	4	1	
																	S. E.	4	2	2	0	0	0	
	Range.	.99	.95	.78	38.50	42.50	40.50	34.	37.50	37.27	29.43	33.	Prt. clr	13	15	8	W.	2	3	4	10	11	3	
																	E.	2	0	2	0	0	0	
	Omitted.	2 da's	7 da's	3 da's	2 da's	8 da's	2 da's		8 da's	13 d's	13 d's	13 d's		2	7	3		3	9	1	10	10	14	2.759

		Barometer.			Thermometer.					Hygr'm'tr, 2 P.M.			Sky.			
		7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean.	Dew point.	Diff bet. dew pt. & temp.	Wet bulb.		7 A.M Days	2 P.M Days	9 P.M Days
April.	Average.	29.61	29.58	29.57	49.98	64.57	53.57	45.37	54.93	47.48	16.81	55.54				
	Maximum.	30.	29.94	29.89	71.	81.50	72.	63.	72.	75.29	32.31	76.50	Ent. clr	7	8	17
	Minimum.	29.08	29.16	29.26	32.	42.50	36.	29.	39.25	30.38	0.00	42.	Ent.cld	5	5	8
	Range.	.92	.78	.63	39.	39.	36.	34.	32.75	44.91	32.31	34 50	Prt. clr	18	15	5
Omitted.			2 da's			2 da's			2 days	3 da's	3 da's	3 da's			2	
May.	Average.	29.45	29.44	29.45	57.81	71.45	60.58	52.52	61.82	56.34	15.11	62.37				
	Maximum.	29.90	29.89	29.87	69.	86.	72.50	65.50	75.25	70.	30.19	74.	Ent. clr	14	4	15
	Minimum.	28.74	28.78	28.98	42.	45.50	40.50	38.	43.25	39.94	0.00	45.50	Ent.cld	7	7	4
	Range.	1.16	1.11	.89	27.	40.50	32.	27.50	32.	30.06	30.19	28.50	Prt. clr	10	19	12
Omitted.			1 day			1 day			1 day	1 day	1 day	1 day			1	
June.	Average.	29.48	29.47	29.47	66.07	78.22	67.32	60.42	69.32	62.86	15.29	64.83				
	Maximum.	29.80	29.81	29.77	78.	89.	76.50	74.	80.	77.99	26.49	80.	Ent. clr	9	4	10
	Minimum.	29.16	29.13	29.16	54	59.	53.	46.50	57.50	46.56	0.00	58.	Ent.cld	7	4	5
	Range.	.64	.68	.61	24.	30.	23.50	27.50	22.50	31.43	26.49	22.	Prt. clr	14	22	15
Omitted.																

		Winds.			Clouds.			Rain.
		7 A.M Days	2 P.M Days	9 P.M Days	7 A.M Days	2 P.M Days	9 P.M Days	Rain Gauge Inches
April.	N.	2	3	4	1	0	0	
	N. W.	5	5	7	2	3	1	
	N. E.	4	1	1	0	0	0	
	S.	6	5	6	0	2	0	
	S. W.	7	9	7	3	6	1	
	S. E.	5	4	3	0	1	0	
	W.	0	0	1	16	5	0	
	E.	1	1	1	0	0	0	
Omitted.			2		2	5	11	4.855
May.	N.	1	2	2	1	1	2	
	N. W.	7	7	6	2	5	2	
	N. E.	5	3	4	0	1	0	
	S.	2	1	1	0	0	0	
	S. W.	4	6	4	0	4	1	
	S. E.	6	4	7	2	4	0	
	W.	0	3	2	6	8	1	
	E.	6	4	5	1	3	0	
Omitted.			1		5	2	10	2.030
June.	N.	5	3	1	1	5	1	
	N. W.	6	8	5	3	6	0	
	N. E.	2	1	2	0	1	0	
	S.	3	2	2	0	0	0	
	S. W.	5	8	7	5	7	0	
	S, E.	3	1	6	0	0	0	
	W.	2	2	4	7	5	3	
	E.	4	5	3	2	2	0	
Omitted.					5	1	16	3.715

Meteorological Journal—continued.

		Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Thermometer. 7 A.M.	Thermometer. 2 P.M.	Thermometer. 9 P.M.	Thermometer. Reg'r.	Thermometer. Mean.	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet. dew pt & temp.	Hygr'm'tr, 2 P.M. Wet bulb.	Sky.	Sky. 7 A.M Days	Sky. 2 P.M Days	Sky. 9 P.M Days
July.	Average.	29.57	29.56	29.56	69.63	81.90	71.13	65.79	74.05	68.08	13.91	70.74				
	Maximum.	29.79	29.79	29.77	79.50	92.50	80.	78.	83.	78.86	20.35	80.	Ent. clr	12	2	20
	Minimum.	29.20	29.27	29.24	60.	70.50	60.50	54.	64.75	54.83	0.00	60.	Ent.cld	4	6	3
	Range.	.59	.52	.53	19.	22.	19.50	24.	18.25	24.03	20.35	20.	Prt. clr	15	21	8
	Omitted.		2 da's			2 da's			2 days	2 da's	2 da's	2 da's			2	
August.	Average.	29.52	29.50	29.51	69.15	79.50	70.61	65.89	73.87	66.46	11.66	71.98				
	Maximum.	29.87	29.87	29.85	78.	89.	79.	74.50	80.625	77.48	30.50	79.50	Ent. clr	9	2	14
	Minimum.	29.24	29.19	29.15	59.50	68.	61.	55.	66.75	54.50	3.	64.	Ent.cld	5	1	2
	Range.	.63	.68	.70	18.50	21.	18.	19.50	13.875	22.98	27.50	15.50	Prt. clr	17	27	15
	Omitted		2 da's			2 da's			2 days	2 da's	2 da's	2 da's			1	
September.	Average.	29.55	29.54	29.56	55.54	71.52	58.33	51.78	61.34	55.11	16.37	61.68				
	Maximum.	29.81	29.81	29.80	68.	82.50	70.	66.	71.	68.75	25.75	71.	Ent.clr	13	4	19
	Minimum.	29.16	29.06	29.13	41.50	62.	46.	38.50	50.50	44.51	0.00	53.	Ent.cld	5	4	3
	Range.	.65	.75	.67	26.50	20.50	24.	27.50	20.50	24.24	25.75	18.	Prt. clr	10	19	8
	Omitted.	2 da's	3 da's		2 da's	3 da's			3 days	3 da's	3 da's	3 da's		2	3	

	Winds.	Winds. 7 A.M Days	Winds. 2 P.M Days	Winds. 9 P.M Days	Clouds. 7 A.M Days	Clouds. 2 P.M Days	Clouds. 9 P.M Days	Rain. Rain Gauge Inches
July.	N.	3	2	1	1	2	0	
	N. W.	7	7	8	1	4	0	
	N. E.	5	3	5	0	0	0	
	S.	7	6	7	1	3	0	
	S. W.	5	4	4	3	6	0	
	S. E.	3	5	5	1	1	0	
	W.	0	1	1	8	8	1	
	E.	1	1	0	3	2	0	
			2		2	3	10	1.530
August.	N.	3	3	2	1	0	0	
	N. W.	6	1	4	3	3	1	
	N. E.	2	0	1	0	0	0	
	S.	7	7	7	2	3	0	
	S. W.	5	6	7	7	9	2	
	S. E.	5	5	8	1	3	0	
	W.	2	5	2	6	16	2	
	E.	1	3	0	2	1	0	
			1		2	1	12	3.010
September.	N.	4	3	4	2	4	0	
	N. W.	10	9	13	2	6	1	
	N. E.	1	1	1	0	1	0	
	S.	5	6	6	0	2	0	
	S. W.	5	6	5	2	3	0	
	S. E.	1	1	1	1	0	0	
	W.	2	0	0	4	6	2	
	E.	0	1	0	0	0	0	
		2	3		4	2	8	1.830

Month		Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Thermometer. 7 A.M.	Thermometer. 2 P.M.	Thermometer. 9 P.M.	Thermometer. Reg'r.	Thermometer. Mean.	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet. dew pt. & temp.	Hygr'm'tr, 2 P.M. Wet bulb.	Sky.	Sky. 7 A.M Days	Sky. 2 P.M Days	Sky. 9 P.M Days
October.	Average.	29.53	29.49	29.52	49.35	62.53	52.50	45.92	54.29	52.38	10.15	56.93				
	Maximum.	29.78	29.78	29.78	68.	79.	70.	67.	68.75	70.53	25.35	73.	Ent. clr	10	9	16
	Minimum.	29.11	29.09	29.01	29.	40.50	32.	27.	34.25	33.29	0.00	38.	Ent.cld	11	9	6
	Range.	.67	.69	.77	39.	38.50	38.	40.	34.50	37.24	25.35	35.	Prt. clr	10	11	9
	Omitted.		2 da's			2 da's			2 days	2 da's	2 da's	2 da's			2	
November.	Average	29.43	29.39	29.40	37.92	49.79	39.98	34.97	42.36	40.86	8.93	45.77				
	Maximum.	29.81	29.85	29.79	50.	62.	55.	49.	53.75	56.76	19.81	59.	Ent. clr	7	9	14
	Minimum.	28.96	29.09	28.91	29.	33.50	30.	26.	32.50	31.35	0.00	33.50	Ent.cld	7	5	6
	Range.	.85	.74	.88	21.	28.50	25.	23.	21.25	25.41	19.81	25.50	Prt. clr	16	16	9
	Omitted.		2 da's	1 day		2 da's	1 day		2 days	2 da's	2 da's	2 da's				1
December.	Average.	29.47	29.44	29.46	24.19	35.56	27.60	21.97	28.77	26.36	9.19	32.71				
	Maximum.	29.91	29.87	29.80	35.	49.	44.50	36.	41.50	42.28	23.41	46.	Ent. clr	11	7	17
	Minimum.	28.98	28.78	28.87	12.50	23.	15.	11.	19.75	3.59	0.00	22.	Ent.cld	9	9	8
	Range.	.93	1.09	.93	22.50	26.	29.50	25.	21.75	38.69	23.41	24.	Prt. clr	11	15	6
	Omitted.															

Month	Winds.	Winds. 7 A.M Days	Winds. 2 P.M Days	Winds. 9 P.M Days	Clouds. 7 A.M Days	Clouds. 2 P.M Days	Clouds. 9 P.M Days	Rain. Rain Gauge Inches
October.	N.	3	3	3	0	0	0	
	N. W.	7	8	7	4	3	1	
	N. E.	2	0	0	0	0	0	
	S.	3	2	1	2	0	0	
	S. W.	8	7	7	3	6	0	
	S. E.	6	6	8	0	1	0	
	W.	1	1	2	3	3	1	
	E.	1	2	3	2	1	0	
	Omitted.		2		7	8	13	4.595
November.	N.	4	5	3	2	0	2	
	N. W.	11	12	13	7	5	0	
	N. E.	2	2	2	0	1	0	
	S.	0	1	0	0	0	0	
	S. W.	3	4	3	3	1	1	
	S. E.	1	1	3	0	1	0	
	W.	8	2	1	6	8	0	
	E.	1	3	2	0	0	1	
	Omitted.			3	5	5	12	2.095
December.	N.	3	1	1	1	1	0	
	N. W.	7	8	9	3	5	2	
	N. E.	6	4	5	0	0	0	
	S.	3	2	4	0	0	0	
	S. W.	4	6	3	1	0	0	
	S. E.	1	0	1	0	0	0	
	W.	7	10	8	10	8	3	
	E.	0	0	0	0	0	0	
	Omitted.				6	10	9	4.300

Meteorological Journal—continued.

Average of 1840.

1840.	Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Thermometer. 7 A.M.	Thermometer. 2 P.M.	Thermometer. 9 P.M.	Thermometer. Reg'r.	Thermometer. Mean.	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet. dew pt & temp.	Hygr'm'tr, 2 P.M. Wet bulb.
Average.	29.50	29.48	29.49	47.73	60.5[illegible]	50.22	44.14	52.42	47.65	12.84	52.91
Maximum.	30.	29.95	29.95	79.	92.50	80.	78.	83.	78.86	32.31	80.
Minimum.	28.74	28.75	28.87	-2.	11.	5.	-2.	7.50	.70	0.00	10.
Range.	1.26	1.2[illegible]	1.08	81.	81.5[illegible]	75.	80.	75.50	78.16	32.31	70.
Omitted.	4 da's	21 d's	5 da's	1 da's	22 d's	1 da's		22 days	31 d's	31 d's	31 d's

Total of 1840.

Sky.	7 A.M Days	2 P.M Days	9 P.M Days
Ent. clr	110	66	180
Ent.cld	95	73	81
Prt. clr	157	209	100
	4	18	5

	Winds. 7 A.M Days	Winds. 2 P.M Days	Winds. 9 P.M Days	Clouds. 7 A.M Days	Clouds. 2 P.M Days	Clouds. 9 P.M Days	Rain. Rain Gauge Inches
N.	33	28	24	12	17	5	
N. W.	87	91	99	37	50	10	
N. E.	40	23	34	1	6	0	
S.	38	36	39	8	8	0	
S. W.	64	76	62	33	53	5	
S. E.	47	32	55	5	11	0	
W.	31	36	31	92	94	17	
E.	21	24	17	10	9	1	
	5	20	5	64	58	147	35.782

Average of Winter Months 1839-40.

Winter, 1839-40.	Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Thermometer. 7 A.M.	Thermometer. 2 P.M.	Thermometer. 9 P.M.	Thermometer. Reg'r.	Thermometer. Mean.	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet. dew pt & temp.	Hygr'm'tr, 2 P.M. Wet bulb.
Average.	29.48	29.44	29.46	28.30	38.59	29.78	25.47	32.30	28.83	9.23	33.68
Maximum.	29.98	29.95	29.95	55.	69.50	58.	52.50	61.	58.38	25.75	62.
Minimum.	28.30	28.46	28.28	-2.	11.	5.	-2.	7.50	.70	0.00	10.
Range.	1.68	1.49	1.67	57.	58.50	53.	54.50	53.50	57.68	25.75	52.
Omitted.		1 day	1 day		1 day	2 da's		1 day	6 da's	6 da's	6 da's

Total of Winter Months 1839-40.

Sky.	7 A.M Days	2 P.M Days	9 P.M Days
Ent. clr	16	15	35
Ent.cld	40	36	45
Prt. clr	35	39	10
		1	1

	Winds. 7 A.M Days	Winds. 2 P.M Days	Winds. 9 P.M Days	Clouds. 7 A.M Days	Clouds. 2 P.M Days	Clouds. 9 P.M Days	Rain. Rain Gauge Inches
N.	6	4	4	1	6	0	
N. W.	29	30	29	19	19	6	
N. E.	18	14	16	6	5	0	
S.	1	6	5	2	0	0	
S. W.	12	14	13	8	11	0	
S. E.	13	4	12	0	0	0	
W.	9	13	11	19	18	1	
E.	3	5	1	1	2	0	
		1	1	20	17	49	8.497

Average of Spring Months 1840.

Spring, 1840.	Barometer. 7 A.M.	Barometer. 2 P.M.	Barometer. 9 P.M.	Thermometer. 7 A.M.	Thermometer. 2 P.M.	Thermometer. 9 P.M.	Thermometer. Reg'r.	Thermometer. Mean.	Hygr'm'tr, 2 P.M. Dew point.	Hygr'm'tr, 2 P.M. Diff bet. dew pt & temp.	Hygr'm'tr, 2 P.M. Wet bulb.
Average.	29.46	29.43	29.45	49.04	63.54	52.41	44.73	54.10	47.28	16.61	55.19
Maximum.	30.	29.94	29.89	71.	86.	72.50	65.50	75.25	75.	30.19	76.
Minimum.	28.74	28.78	28.94	20.50	32.50	24.	19.	25.75	22.73	0.00	30.
Range.	1.26	1.16	.95	50.50	53.50	48.50	46.50	49.50	52.27	30.19	46.
Omitted.	2 da's	10 d's	3 da's	2 da's	11 d's	2 da's		11 days	17 d's	17 d's	17 d's

Total of Spring Months 1840.

Sky.	7 A.M Days	2 P.M Days	9 P.M Days
Ent.clr	26	16	45
Ent.cld	23	17	19
Prt.clr	41	49	25
	2	10	3

	Winds. 7 A.M Days	Winds. 2 P.M Days	Winds. 9 P.M Days	Clouds. 7 A.M Days	Clouds. 2 P.M Days	Clouds. 9 P.M Days	Rain. Rain Gauge Inches
N.	6	6	8	3	1	2	
N. W.	17	20	23	6	10	3	
N. E.	11	5	10	0	1	0	
S.	9	6	8	2	2	0	
S. W.	20	22	15	4	14	3	
S. E.	15	10	12	2	5	0	
W.	2	6	7	32	24	4	
E.	9	5	8	1	3	0	
	3	12	1	17	17	35	9.680

	Average of Summer Months 1840.											Total of Summer Months 1840.			
	Barometer.			Thermometer.					Hygr'm'tr, 2 p.m.			Sky.			
	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Reg'r.	Mean.	Dew point.	Diff. bet. dew pt. & temp.	Wet bulb.		7 A.M Days	2 P.M Days	9 P.M Days
Summer, 1840. Average.	29.52	29.51	29.51	68.28	79.87	69.69	64.03	72.41	65.80	13.62	69.18				
Maximum.	29.87	29.87	29.85	79.50	92.50	80.	78.	83.	78.86	30.50	80.	Ent. clr	30	8	44
Minimum.	29.16	29.13	29.15	54.	59.	53.	46.50	57.50	46.56	0.00	58.	Ent. cld	16	11	10
Range.	.71	.74	.70	25.50	33.50	27.	31.50	25.50	32.30	30.50	22.	Prt. clr	46	70	38
Omitted.		4 da's			4 da's			4 da's	4 da's	4 da's	4 da's			3	
	Average of Autumnal Months 1840.											Total of Autumnal Months 1840.			
Autumn, 1840. Average.	29.50	29.48	29.49	47.67	61.28	50.27	44.22	52.68	49.45	8.86	54.79				
Maximum.	29.81	29.83	29.80	68.	82.50	70.	67.	71.	70.53	25.75	73.	Ent. clr	30	22	49
Minimum.	28.96	29.06	28.91	29.	33.50	30.	26.	32.50	31.35	0.00	33.50	Ent. cld	23	18	15
Range.	.85	.77	.89	39.	49.	40.	41.	38.50	39.18	25.75	39.50	Prt. clr	36	46	26
Omitted.	2 da's	7 da's	1 day	2 da's	7 da's	1 day		7 days	7 da's	7 da's	7 da's		2	5	1

	Winds.			Clouds.			Rain.
	7 A.M Days	2 P.M Days	9 P.M Days	7 A.M Days	2 P.M Days	9 P.M Days	Rain Gauge Inches
Total of Summer Months 1840.							
N.	11	8	4	3	7	1	
N. W.	19	16	17	7	13	1	
N. E.	9	4	8	0	1	0	
S.	17	15	16	3	6	0	
S. W.	15	18	18	15	22	2	
S. E.	11	11	19	2	4	0	
W.	4	8	7	21	29	6	
E.	6	9	3	7	5	0	
Omitted.		3		9	5	38	8.255
Total of Autumnal Months 1840.							
N.	11	11	10	4	4	2	
N. W.	28	29	33	13	14	2	
N. E.	5	3	3	0	2	0	
S.	8	9	7	2	2	0	
S. W.	16	17	15	8	10	1	
S. E.	8	8	12	1	2	0	
W.	11	3	3	13	17	3	
E.	2	6	5	2	1	1	
Omitted.	2	5	3	16	15	33	8.520

Architecture.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A Description of the Eastern Penitentiary, of the State of Pennsylvania, designed and executed by JOHN HAVILAND, ESQ., *Architect.*

This admirable specimen of prison architecture is situated in the North-western environs of Philadelphia, about two miles from the centre of the city; it occupies an elevated site near the river Schuylkill, and presents one of the noblest, and most commanding architectural objects, in the country. It was commenced in the year 1822, and completed in 1837, at an expense of 600,000 dollars.

The principal front is 670 feet in length, and is wholly composed of finely wrought granite, accurately jointed, and employed in unusually large masses.

The character of the composition is strikingly appropriate to the objects of the building; its bold and massy features, its broad lights and deep shadows, its well proportioned and well managed openings, and the expressive unity of design which characterizes the whole, produce on the mind of the spectator a most solemn and impressive effect.

The entire façade is *castellated*, and its embellishments are in the "early pointed," or "lancet" style of English Gothic. The gate of entrance, which occupies the centre of the front, is fifteen feet wide by twenty-seven feet high; the upper portion of it is secured with a massive wrought iron port-cullis, and the lower part with immense oaken gates, studded with projecting iron rivets; the jambs of the opening are strengthened by massy buttresses, which, at the same time, impart a bold architectural effect to the composition.

On either side of the entrance a square tower is constructed, of fifty feet in height, crowned with an embattled parapet, supported by pointed arches springing from corbels. These towers define the extent of the centre building, which is about 200 feet, and their projection from the face of the main wall is ten feet. The curtain between the towers is also embattled, and its height from the ground is forty-one feet.

The extremities of the front are finished with octagonal towers pierced with loop-holes and pointed windows, and crowned with embattled parapets; and a massy octagonal tower rises out of the centre of the front to the height of eighty feet, thus forming a picturesque termination to the group.

The outside walls are thirty feet in height, twelve feet thick at the

base, and 640 feet in length on each side, thus enclosing a space equal to about *ten* acres.

The cells are built in *seven* blocks or ranges, radiating from seven sides of an octagonal building of forty feet in diameter, situated in the centre of the enclosure. The cells of each block are built on either side of a spacious corridor, and these corridors all lead to the centre building, thus affording a view of every cell door in the whole establishment from one and the same point of sight. The upper part of the centre building constitutes an observatory, from which a complete supervision may be had over the entire enclosure; and the lower part, or cellar, contains a reservoir for supplying the establishment with water.

The whole number of separate cells contained in the *seven* ranges, amounts to 844. The three blocks which were first erected are but one story in height, and to each cell is attached a separate yard of eighteen feet long by eight feet wide, surrounded by a wall of twelve feet in height; these enclosures were intended as airing yards for the prisoners, but it has been found, by experience, that the ample dimensions of the cells, and their perfect ventilation, render it unnecessary to remove the prisoners *at any time* from their cells, except in case of sickness; hence, in the four ranges which were subsequently erected, the yards have been omitted, and the cells made two stories in height. The second stories are approached by means of galleries extending along the corridors, supported by cast iron brackets; the stairs, and the ballustrading on the galleries are also composed of cast iron.

The cells of the different blocks, or ranges, differ in dimensions, the smallest being eleven feet nine inches long by seven feet six inches wide, and the largest, fourteen feet nine inches long by nine feet wide. Each cell has a separate hydrant, a water closet, an aperture for admitting pure air, and a flue for ventilation.

The whole prison is warmed on Perkin's plan of hot water circulation through iron pipes, and those who have the management of the institution seem to be satisfied that the plan is a good one for such an establishment.

The front building, through which the prison is entered, contains, on the right of the gate-way, commodious apartments for the Warden, and chambers for the meetings of the Inspectors. On the left, are the clerks' offices, and the rooms of the deputy keepers. Over the entrance, on the second floor, are the apothecary's apartments, and in the left wing, the infirmary.

A high degree of architectural taste and skill is evinced in the whole design of this noble and costly structure, while the beauty and

solidity of its execution are equally creditable to its accomplished and tasteful architect, John Haviland, Esq., whose name it is destined to transmit with honour and renown to after ages.

T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1840.

With Remarks and Exemplifications by the Editor.

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1. For an *Electro Magnetic Telegraph;* Charles Wheatstone and William Fothergill Cooke, of Great Britain, June 8. Patent for 14 years from the 12th of June, 1837, that being the date of the English patent.

It would be fruitless to attempt even a sketch of this apparatus as the specification covers 52 pages of folio with numerous references to complex drawings. The claims which cover more than four pages of folio need not be given, as they could not be understood without the drawings to which they refer. The instrument is used for giving signals and sounding alarums in distant places by means of electric currents transmitted through metallic circuits. The specification is published at large in some of the English Journals.

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2. For improvements in the *Machine for Cutting Corks;* Samuel Sawyer, Boston, Massachusetts, June 10.

The corks are cut by a revolving circular knife, which is sharpened, during the operation of the machine, by a revolving whetstone. The cork is griped between two revolving borders working in a vibrating frame by which it is moved towards and from the revolving knife. The taper is given to the cork by having the axis of one of the holders below that of the other. Two or more frames with holders, &c., can be placed around the knife, which revolves horizontally, the axis of the vibrating frame or frames being immediately under its edge. A clear idea of the arrangement of the machinery which gives motion to the vibrating frames and holders, &c., could not be given within the limits of a brief notice.

The claims are, 1st, to the method of rounding or forming the cork by means of the revolving circular knife in combination with a movable or vibrating frame operating in the manner described in the specification. 2nd, to the sharpening of the revolving knife while in operation, by means of a revolving whetstone. 3rd, to the causing of both holders to revolve by means of the system of bands and pulleys described, thereby preventing the liability to twist the cork, while in the process of formation. The 4th claim is to a peculiar arrangement of the apparatus for withdrawing one of the holders to discharge the cork which has been cut, and to receive another. The 5th is to certain matters of minute detail, explained by reference to the drawings.

3. For an improvement in the manner of constructing a *Cooking Stove*; William Gallup, Norwalk, Huron county, Ohio, June 10. (See specification.)

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4. For an *Ever-pointed Pencil Case;* Thomas Woodward, Brooklyn, New York, June 10.

The pencil holder slides within the lining of the pencil case, and has a pin projecting from its upper end which slides in a straight slot in the said lining, and the pencil is prevented from being forced in when writing by means of a notch at the lower end of the straight slot into which the before mentioned pin is forced. The pencil-holder and pencil are worked in and out by a section of the outside casing which revolves upon the lining, it being provided with a spiral channel or slot inside, into which the end of the pin that passes through the straight slot fits. This last mentioned revolving tube is prevented from sliding up and down by the upper and lower portions of the tube which are permanent. By turning the revolving tube with the spiral groove, or slot, the pin on the holder is made to slide in and out, and when at the bottom of the straight slot it is forced into the notch at the end thereof, and is thereby prevented from being forced in until it has been turned and relieved from said notch.

The claim is to the "forming of the spiral channel for protruding and retracting the pencil-holder within the sectional tube, and combining this tube with the other parts of the case under the particular arrangement set forth so that the upper and lower portions shall remain stationary whilst it is made to revolve. And also the manner of locking the point by the combined operation of the straight and spiral slots as set forth."

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5. For an improvement in the *Spring Bolt of Doors and other Locks;* Geo. W. and Ezra B. Robinson, Boston, Massachusetts, June 10.

The following is an extract from the specification, together with the claim: "Our said improvement consists in inserting a bar of steel or other metal which may be about a quarter of an inch square for an inside door lock, and about seven-eighths of an inch long, (and longer or shorter for other locks in proportion,) into a longitudinal slit in the projecting end of the spring bolt, the bar to project just as far from the box of the lock as the bolt does, and to enter into the box at the other end just far enough to turn upon a pivot passing through the bar and through the bolt. The inner end of this bar is rounded off on the side which sets against the lock plate, and on the opposite side, and between the pivot and the inner end of the bar is a transverse groove into which the end of a flat spiral spring plays, to bear the rounded corner down against the lock plate, and so elevate the opposite end of the bar which projects from the box at an angle of about forty-five degrees with the bolt; the other end of the flat spring is fastened to the bolt nearer to the end, which is connected with the knob

by which the bolt is drawn back. The bar being thus elevated by the pressure of the spring upon the inner end of it, when the door shuts, the end of the bar first comes in contact with the catch, and as the door closes the bar is pressed into the box, turning at the same time on the pivot and carrying the bolt in with it without any friction against the catch, and the door is shut very easily and quietly."

"What we claim as our invention, and desire to secure by letters patent, is the bar of metal turning on a pivot in the spring bolt, and provided with a spring in combination with the spring bolt for the purpose and in the manner described."

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6. For improvements in the *Baker for Culinary Purposes;* Gardiner Chilson, Boston, Massachusetts, June 10.

This is a modification of that kind of baker in which the double reflector is used in combination with, and united to, a cylindrical or elliptical furnace; it consists of an elongated chamber, placed above the radiating chamber and furnace, and divided into three compartments provided with boiler holes at the top, and separated from each other by two partitions. There are valves, or dampers, to regulate and conduct the draught through either, or all, of these compartments, and then out at the pipe. The claim is to the elongated hot air chamber (divided into apartments) with the elliptical or cylindrical furnace, "and also the combination of the latter with the double reflecting baker surrounding the same, the whole being constructed and arranged substantially in the manner above set forth, for the purpose of retaining and circulating the heat throughout the apparatus, and causing it to accomplish the several operations above mentioned in a very effectual manner and with great economy of fuel."

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7. For an improvement on the *Rotary Steam Engine;* James Moore, Elizabethtown, New Jersey, June 10.

This patent was obtained for what the patentee calls "an improvement on the Rotary Steam Engine, patented by John Drummond, on the 3rd of August 1839, and noticed in this Journal, Vol. xxvi. p. 158.

The channel for the piston is formed by the union of two disks, each having half the chamber, and from the shaft to within a short distance of the said channel, each disk is hollowed out to make a chamber. The piston is connected with the shaft by a thin plate of metal which passes between the two disks, or rather between the two ridges made by the chamber near the shaft and the channel for the piston, hence there must necessarily be a space left between these two ridges for the escape of steam. Mr. Drummond, in his engine, has endeavoured to prevent this by the elasticity of the packing; but it must be evident that the plate, which forms the connexion between the shaft and piston, in running round will prevent the packing from closing so as to exclude the steam. In the present patent this is attempted by means of a spring ring, the inner edge of which is attached to the lower disk, the outer edge resting upon the upper disk. A friction roller attached to an arm on the shaft travels in front of the

connecting plates and forces down the spring to allow it to pass, the elasticity of the ring closing it up after the plate has passed. The patentee says, "what I claim as my invention, &c., consists in the arrangement of the circular spring plate inside the cylinder for closing the joint between the plates forming said cylinder, to prevent the escape of steam, in combination with the roller for contracting said spring plate, in order to allow the arm to pass round."

We rarely meet with a new patent for a Rotary Steam Engine, without regretting the little information that is possessed by those whose aim it is to show their knowledge upon the subject, by professing to have improved this instrument. We have taken repeated opportunities of making known our own conviction that the production of a rotary engine which shall be equally efficient and economical with the reciprocating, is scarcely within the bounds of possibility. Not merely because the parts of a rotary engine, under most of its forms, are more subject to friction and wear than the reciprocating, but from causes which are inherent, and which, therefore, the highest talent and skill cannot surmount. There was a time, it is true, when this conviction did not exist, and the thing was attempted by a Watt, and by others distinguished for their knowledge in the matter; but few, however, of the two hundred patents which have been obtained in England and in this country were then in being, but they now exist, or rather have existed, as sunken rocks, which serve, in general, to deter all those who know how to consult the chart from venturing on a navigation where there is little else than shoals.

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8. For an improvement in the *Horse Power;* Enoch Piper, Camden, Waldo county, Maine, June 10.

This patent is taken, for an improvement on the endless chain horse power, and the improvement consists in a peculiar mode of sustaining the endless floor on which the horse treads. The claim appended to the specification will give a sufficiently clear idea of the principle. "Now what I claim as my invention and improvement is the mode of arranging and sustaining the floor planks by attaching the middle of each of the belts midway between the axles of the trucks, and bringing their ends to bear on the axles, yet with liberty to rise from the axles in passing around the drums as set forth in the foregoing description, and in any similar manner embracing analogous arrangements or principles of action."

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9. For a mode of *Applying the waste heat of Blast Furnaces to Steam Boilers;* Martin Bell, Antis Township, Huntingdon county, Pennsylvania, June 10.

As the waste heat of furnaces has long since been applied to generate steam in boilers, the claim in this patent has been limited to the peculiar arrangement of the flues and the boilers, so that the flame, smoke, &c., may either be carried through the flues of the boilers, or directly out of the chimney of the furnace, and as this arrangement could not be made very clear without drawings, we merely add the

claim, which is in the following words, viz: "Having thus fully described the manner in which I construct my flues and boilers for the purpose of employing the waste heat of a blast furnace for the generating of steam, to be applied to the working of a blowing apparatus, by which the furnace itself may and can be blown, and the necessary blast furnished therefor, and for other purposes; what I claim therein as constituting my invention and discovery, and which I desire to secure by letters patent, is the arrangement of flues and other necessary appendages as herein before described, by which I connect a pair or pairs of boilers with a blast furnace, substantially in the manner set forth and described, thereby applying the flame and heat escaping out of the top of the furnace, to create a steam power, which may be used to blow the furnace, and which may also be applied to other purposes."

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10. For a mode of *Sustaining Metal Roofs;* Peter Naylor, New York city, June 12.

The plates of metal constituting the roof are united together by riveting, and are bent so as to form a series of arches. Iron truss frames extend across, and above, these plates from wall to wall, upon which they rest as abutments. The metal roofing is suspended to these truss frames by screw bolts. The metal roofing may be formed in various ways, the particular construction of this part not being claimed as constituting any part of the invention. The claim is in the following words, viz: "Having thus fully explained the nature of my invention, and shown the manner in which I carry the same into operation; what I claim as constituting my improvement, and desire to secure by letters patent, is the combining of iron truss beams, constructed in the manner herein described, with the plates constituting the metallic roofing, the said truss beams being placed above the roofing, and sustaining the same upon the suspension principle, substantially as herein described."

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11. For an improved *Hill Side Plough;* Daniel Gochnour, Jr., Conemaugh Township, Cambria county, Pennsylvania, June 12.

A mouldboard with two shares, each alternately answering the purpose of a coulter, is connected with the land-side, which is the same on either side, by means of two pivots, one on the forward end of the land-side, fitting into a hole in the share, and the other on the end of a brace attached to the back part of the mouldboard, fitting into a hole in the heel of the land-side, so that the mouldboard can be shifted by turning under the land-side. The mouldboard is fastened by a bolt that passes through a mortise in the beam, and turning on a pin therein, the lower end of which catches on to that share which acts as the coulter, and the upper end jointed to a connecting catch rod worked by the ploughman. The claim is in the following words, viz: "What I claim as my invention and constituting my improvements on the Teeter Plough, is the manner in which I have combined the mouldboard with the land-side by making the mouldboard turn on the point of the land-side, instead of on a roller placed

in the bar of the land-side at a distance from the point as in the Teeter plough, by means of which arrangement I am enabled to use the shares of the Teeter plough alternately as a coulter and share, thereby dispensing with the ordinary fixed coulter employed in said Teeter plough. I also claim in combination therewith, the method of securing the mouldboard to the alternate sides of the land-side by means of the catch and rod as described."

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12. For an improved mode of constructing the *Mouth-pieces for Mail Bags, Traveling Bags, &c.;* James Sellers and Abraham L. Pennock, Philadelphia, Pennsylvania, June 12.

We will quote the following from the specification, viz: "Our mode of making such mouth-pieces, we modify in various ways, but in each of them the mouth-piece consists of three or more pieces or sides, so arranged that two or more of them, which must be inflexible, connected by a single fastening, confine the remainder. If formed of three pieces or sides, two of them are of wood, metal, or other inflexible material, hinged or jointed together by a flexible connexion, and one of them of a flexible material. If formed of four or more pieces or sides, all of them are made of an inflexible material, hinged or jointed together by a flexible connexion, or at least so many of them as are requisite to confine effectually the mouth of the bag when closed. When flexible pieces are employed, they are to be contained, when the mouth is closed, between other pieces which are inflexible. When our mouth-pieces form a figure not exceeding four sides, two opposite sides are to be united for the purpose of fastening the whole. In figures of six sides, when all are external, the two middle pieces are to be united; in figures where all the sides except two, are included between, or held confined by, two external or controlling pieces, these controlling pieces are to be united; and in radiating figures, the pieces composing alternate sets are also to be united. In each case this union is to be effected by some means appropriate to the purpose, and by which a catch, lock, or other device for securing the mouth may be attached. Such means may consist of plates projecting from those pieces, in a line coinciding with the face line of such pieces, and a hasp to confine them, the hasp being secured at one end by a hinge, and at the other, held down by the shackle of a padlock, or other catch, passing over such hasps, and through one or more of the projecting plates; or when the connexion is effected by the union of two pieces only, the ligament, when other convenience does not forbid, may be a staple fastened to one piece, and passing sufficiently through the other to admit of attaching the required catch, or lock. What we claim as our invention, is the making of such mouth-pieces so that they shall consist of three or more sides, and be so formed and arranged upon the principle, and in the manner herein shown, that two or more of the sides which must be inflexible, shall confine the remainder by a single fastening, the flexible portions when used being embraced and confined between other portions which are inflexible, in the manner herein shown."

13. For *Ponton Equipages for the use of Armies;* E. M. Huntington, Administrator of John F. Lane, Terre Haute, Lousiana, June 17. (See specification.)

14. For improvements in the *Machine for pressing Hats, Bonnets, and other articles;* Richard Murdock, Baltimore, Maryland, June 17.

This patent was granted for improvements on a machine long since used for pressing hats, &c., in which the hat to be pressed is placed on a block attached to a revolving shaft, and the irons applied to the various parts of the hat by a lever.

The improvements claimed are for various modifications of the machinery, and it would be difficult to give a clear description of them without drawings, to which the claims refer.

15. For an improved *Bathing Apparatus;* George S. Byrd and Peter Milne, New York City, June 17.

The bathing tub is to be placed in the story next above the kitchen, and six or seven feet above this tub is placed a reservoir of cold water, at the bottom of which there are two valves opening upwards, and to be operated by the necessary connexions placed within the reach of the person bathing. From one of these valves a pipe descends to the boiler in the kitchen, in which boiler the pipe is coiled, and thence ascends to a "compound standing pipe" leading to an aperture in the bottom of the bathing tub, so that the water which descends in the tube becomes heated, and rises to supply the hot water. Another pipe descends from the second valve in the bottom of the reservoir also to the "compound standing pipe," to supply the cold water, both passing into the bathing tub through the same aperture. The "compound standing pipe" is provided with a valve, opened by a connexion within the reach of the person bathing, to discharge the water in the bathing tub. It is also provided with an overflow pipe, which branches off from the "compound standing pipe" upon a level with the line to which it is desired that the water shall rise in the tub. By the above arrangement it will be seen that the hot and cold water are supplied through the same hole in the bottom of the bathing tub through which the water is discharged. The patentees say, "what we claim as our invention, and desire to secure by letters patent, is the compound standing pipe, as described, together with the mode of supplying hot and cold water to bathing tubs, by means of the compound standing pipe, &c., and the combination with the same of the overflow pipe, the whole being constructed in the manner, and for the purpose described."

16. For improvements in the *Stove and Kettle for making Varnish, Cooking, &c.;* Harman Hibbard, Utica, Genessee county, New York, June 17.

We are told by the patentee that the "nature of his invention con-

sists in constructing an apparatus styled "the economic stove," with appendages to perfect its utility. We are also informed that he "produces, and regulates, and applies the same to a variety of purposes, such as culinary uses, and making varnish," &c., and after specifying many advantages and various purposes to which it may be beneficially applied, he concludes by limiting his claim to the "constructing of stoves for making varnish, or other purposes, with a movable furnace, moved, raised, or lowered, by hand, lever, crank, spring, or other similar arrangement, so as to regulate the distance of the fire from the kettle, or other utensil, to which the heat is to be applied; likewise the application of the stirring tube and concave lid to, or its combination with, the varnish kettle, as set forth." We apprehend that the great number of objects to which he intends to apply this invention will scarcely enable him to sustain the first section of his claim, should he have occasion to prosecute any one for the infringement of his patent, as stoves have long since been made with a movable furnace; and no special combination or arrangement of parts is pointed out, to enable us to tell upon what foundation the claim rests.

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17. For a mode of *Setting the Bricks in a Brick Kiln;* Henry Read, Kensington, Philadelphia county, Pennsylvania, June 17.

In arranging the bricks, as stated in the specification, arches are made in the usual manner, except that they are less in number, and flues are made running from arch to arch, between every two bricks, and extending from the bottom of the arch about two and half inches in width to within one brick from the top, and then covered over. The claim is in the following words, viz: "What I claim as my invention is the above manner of setting the bricks in a kiln, for the purpose of burning; that is to say, I claim the leaving of flues for the free passage of the flame and draught between every two or three lengths of bricks; said flues extending from arch to arch, throughout the whole length of the kiln, and being arranged and constructed substantially, in the manner herein set forth."

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18. For a mode of *Warming Buildings;* John A. Stewart, of Philadelphia county, Pennsylvania, June 17.

The walls of houses are to be made double, and the spaces between the two walls are to constitute flues, so that the draught from the fires will pass through these spaces.

The patentee concludes by saying, "I am aware that double walls, resembling those described by me, have been heretofore constructed for the purpose of protecting the interior walls from the effects of moisture, and also with a view to obviate, in some degree, the effect of change of temperature, a stratum of air being thereby interposed between the outer and inner portions; I do not, therefore, make any claim to a structure of this kind so far as it is adapted and applied to the purpose above mentioned. But what I do claim as constituting my invention, and which I desire to secure by letters patent, is the formation of the spaces between such double walls into flues, in such

a manner as that the draught from fire-places or stoves of any kind may be made to pass between said walls, in the manner described, whereby they will be kept perfectly dry, and a large portion of the heat usually lost, will be conducted and radiated into the rooms; the whole being constructed, and operating substantially, as herein described."

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19. For an improvement in *Axletrees and Boxes of Carriages;* Lyman Smith, Jr., and Griffin R. Waring, Derby, New Haven county, Connecticut, June 17.

This patent is for a mode of connecting the hub to the axletree without a linch-pin; and for this purpose the inner end of the box of the hub is provided with a flanch, and the axletree with a cap which passes over the flanch on the box or hub; set screws, or a key, pass through the cap and in front of the flanch on the box, so that the hub and box can be taken from the axletree without removing the set screws or key. The claim is to the "method of securing the box or wheel in its place on the axle by means of the flanch on the box, the cap on the axle, and the set screws on the key, in the manner described, instead of using the linch or nut on the end of the axle."

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20. For improvements on the *Truss for the Cure of Hernia;* William B. Dodson, city of Louisville, Kentucky, June 17.

As the specification of this patent is of great length, and the claim refers to the drawings, which are numerous, and could not be understood without them, we will not attempt any description of the invention.

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21. For an improvement in the *Whippletree for Carriages;* James Jorey, Stafford, Tolland county, Connecticut, June 17. Assigned to B. Fowler, Jr.

The patentee says, "The nature of my invention consists in applying a yoke to the centre of the whipple-tree to prevent its becoming disengaged in that point, and two studs called side guards attached to the cross bar of the thills of carriages, to prevent too great vibration of the whipple-tree." "What I claim as my invention, and desire to secure by letters patent, is the employment of the yoke in combination with the whipple-tree and central pin, as described, and also the wing guards in combination with the whipple-tree, for the purpose and in the manner described."

The yoke is a strap of iron which passes around the thills and the middle of the whipple-tree, where it is jointed to the thills, so that should the pin by which the two are jointed give way, the whipple-tree will be retained by the yoke. The wing guards are two iron studs attached to the cross bar in front of the whipple-tree, and near each end of it, so set that they allow sufficient play to the whipple-tree, and should one of the traces break, will prevent it from swinging too far.

22. For an improvement in the *Straw Cutter;* Joseph Worley, Hawkins county, Tennessee, June 20.

This straw cutter has the feeding box standing vertically, and the knife cutting by a horizontal sliding motion. An arm extends from each of two vibrating beams, and the knife is jointed to these arms. One of said arms extends out beyond the point at which the knife is jointed to it, and is connected with a crank pin on a fly wheel by a connecting rod, so that as the crank revolves the beams vibrate, and thus give to the knife an oblique, or draw, cut. The press block which holds the straw whilst the knife is cutting, is pressed up by a spring, and thrown back to allow the straw to descend, by a cam on the fly wheel, which works against the end of a connecting rod jointed to a lever, one end of which forces back the spring which bears against the press block. The claim is as follows, "What I claim as my invention is my plan of giving to the knife an oblique or draw cut, by means of the vibrating beams to which the knife is attached, as above described. Also the means by which the press piece is made to operate, consisting of the combination of the spring, the lever, and the connecting rod, acted upon by the cam on the fly wheel, as described. Also the particular manner in which I have combined said press piece, hopper, and knife, as herein set forth."

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23. For an *Argand Burner for Burning Spirits of Turpentine;* Charles Carr, Philadelphia, Pennsylvania, June 20.

This patent is obtained for adapting the burner of oil lamps to the burning of spirits of turpentine. The inside tube of the turpentine burner is extended some distance above the top of what is the burner when made for oil, and is armed with points inclining upwards. To the outer tube is adapted a sliding tube, which at its upper end is of a conical form, and approaches at its mouth so near to the inner tube as just to allow space for the free passage of the strip of cotton cloth forming the wick; this is armed within with points similar to those on the inside tube, and by means of these two sets of points the wick may be raised. As the outer tube is slid up the points catch the wick and carry it up, and when drawn down, the points on the inner tube catch it and prevent it from sliding down. The patentee claims the "manner in which he has connected and combined the sliding tube with the ordinary Argand's oil burner, so as to adapt it to the burning of the spirits of turpentine, and to the raising of the wick, as set forth."

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24. For a *Mowing Machine;* Seth Lamb, New York City, June 20.

Sickles are attached to the rim of a horizontal wheel in the front of the machine—they are curved in the usual way, are provided with teeth, and are so placed as to incline in the direction of the motion of the wheel. As the wheel revolves, the sickles pass between guides, or fingers, placed below, and extending out in front and beyond the end of the sickles, and bows, or guards, which reach from the points of the guides, or fingers, being attached to them, to some distance

back of the point where the sickles are affixed to the rim of the wheel. On each side of the front of the machine there is a guide inclining out, so that the grain, as it is cut, is gathered in, and made to pass over the sickle wheel within that part of its diameter where the gearing to drive it is placed. The guides, or fingers, may be made with a sharp edge, or with teeth like the sickle. The grain is deposited on a platform at the back of the sickle wheel, and on a level with its top; and by the side of this platform there is another, somewhat elevated, on which the grain is placed when removed from the first, and there made into sheaves, whilst the machine is in motion.

The claim is to the combination of the bows, or guards, with the guides, or fingers, the sickles and the guards at the sides of the front of the machine. Also the platform on which the grain is placed to be made into sheaves—and, finally, the "placing of the sickle wheel and its appendages at the inner side of the machine, so as to permit the horse to travel by the side of the grain in front of the machine, and to allow the platform (on which the sheaves are made,) to extend by the side of it, for carrying the grain."

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25. For a *Cooking Stove;* Charles Guild, Cincinnati, Ohio, June 20.

This patent has been granted for a peculiar arrangement of the flues and dampers, which could not be clearly described without reference to drawings. The oven is placed below the fire chamber, the bottom of the latter being the top of the former. The fire chamber and the oven are both divided into two compartments by a movable partition. The space around the oven is divided into four flues by three partitions, and the arrangement of these, with the dampers, for the purpose of giving a proper direction to the draught as the entire, or only half, of the fire chamber, and one, or both, the ovens are used, forms the subjects of the claim, which need not be given, as it refers to the drawings, and could not be clearly understood without them.

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26. For an *Electro-Magnetic Telegraph;* Samuel F. B. Morse, New York City, June 20.

This patent was granted for an arrangement of signals and types, adapted to a dictionary or vocabulary of words, and for an arrangement of machinery for transmitting signals by means of electro-magnetism, or galvanism. The specification is long, the drawings complex, and the subject one which could not be understood without a full description thereof, and we will not undertake to give a mere sketch of it. The subject could not be justly treated in this way, and it is the less necessary, as the nature and merits of the invention have been spoken of in several of our journals. The subject had been pursued by Professor Morse for a number of years, before he obtained his patent; and in the arrangement of the parts of his machinery there is a manifestation of much skill, in adapting the means to the attainment of the proposed end.

27. For a *Churn for making Butter;* Allen and William A. Crowell, Salisbury, Litchfield county, Connecticut, June 20.

The patentees say that the nature of their invention consists "in the formation of a chamber, or space, in the lower part, or the bottom of the churn, or adjoining any part thereof, for containing hot or cold water, or other liquids, for the purpose of tempering the milk or cream in the churn to the proper degree of heat required for churning, so that it can be done easily, and rapidly, to the will." They have described their improvement as applied to that kind of churn in which the cream is put into a vessel, the bottom of which is semi-cylindrical, and made of metal, and the dashers attached to arms projecting from a horizontal shaft. The chamber for hot, or for cold water, is outside of the metallic semi-cylindrical bottom. The claim is confined to this device for keeping the cream to the proper temperature; in which, however, there is no novelty.

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28. For an improvement in the *Mortising Machine;* Andrew Bailey, Jefferson, Ashtabula county, Ohio, June 20.

This is alleged to be an improvement on that kind of mortising machine in which the chisel is attached to the lower end of a sliding rod, so that it can be swiveled around to cut to the right or left, the upper end of the rod being jointed to a lever, worked by a treadle. The improvement consists of a peculiar mode of making the swivel chisel socket, which has a stem passing into a hole in the chisel rod, and is retained there by a segment of a ring collar which passes on to a groove made in the stem of the chisel socket, there being a lateral mortise through the lower part of the chisel stock to admit of its being put on; the collar rests upon the lower part of the mortise and connects the chisel socket and stock, admitting of a free rotary play to the former. When it is desired to prevent them from turning, the two are connected together by a right angled piece, one link of which passes into a hole made in the chisel socket, running down from the shoulder which bears against the bottom of the chisel stock, and the other passes out through a lateral square aperture made one-half in each piece. That link of the right angled catch which runs down the chisel socket has a spiral spring wrapped around it, and bearing it up, so that the socket cannot turn, but when it is forced over so as to clear that part of the aperture which is in the chisel stock, it turns freely. By having two such apertures, the chisel socket can be turned to each of them and held in place. The claim is confined to the combination of the swivel chisel stock, chisel socket, and spring catch, constructed and operating as described.

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29. For a *Cheese Press;* J. A Fletcher, Irasburg, Orleans county, Vermont, June 20.

The follower of this press slides in the two opposite and vertical sides of a frame, and above the follower, a lever is jointed to each of these side pieces, the shorter end bearing upon the follower, and the longer end being attached to a cord by which the whole press is sus-

pended, so that the pressing is effected by the weight of the press as well as by that of the cheeses to be pressed, and in this particular it differs from all other cheese presses which we have seen. The patentee says, "what I claim as constituting my invention, and desire to secure by letters patent, is the so forming and combining the respective parts, as herein described, that the whole press, with its load, shall be suspended by the longer arms of the lever, and the shorter arms be thereby caused to act upon the follower as set forth."

30. For a *Cooking Stove;* Horace Strickland, Bradford, Orange county, Vermont, June 27.

In this stove, the oven is placed behind the fire chamber, there being two plates between them with an open space for the free circulation of the air of the room. The space over the top of the oven is divided into three by two partitions running from front to back. The exit pipe is placed over the back end of the middle division of the top. The valves are so arranged that the draught may be carried along the side divisions over the top, down the back, along the bottom, up the front, and along the middle division to the exit pipe; or else down the front, under the bottom, and up the back to the exit pipe, a portion of the draught at the same time passing over the top to the exit pipe also. Two small furnaces with boiler holes are placed at the back end of the top, one on each side, with a pipe leading from each to the exit pipe.

The claim is in the following words: "What I claim as my invention, and desire to secure by letters patent, in the above described stove, is the particular manner in which I have arranged the flues around the oven by dividing the upper flue into three parts, and governing the passage of the draft through the middle section by means of the two dampers, operating as herein set forth. I also claim the manner in which I have combined and connected the small furnaces with the stove and its flue for the purpose described." "I do not claim the mere carrying of the flue around the oven, nor the dividing the upper flue into three sections, this having been before done, nor do I claim the employment of valves or dampers generally, but I limit my claim in these particulars to the special arrangement made by me of the said dampers and flues as herein set forth."

31. For a *Portable Saw-Mill;* Samuel Hamilton, New York City, June 27.

The frame, on which the log is secured to a permanent head stock, is nearly upon a level with the ground line, and the frame on which the machinery moves that works the saw, is erected above, so that the saw projects below this framing and through the log, and the frame and machinery to which it is attached and by which it is worked, slide on ways in the manner of the carriage of a common saw mill. The saw therefore moves up to the log instead of the log moving up to it. The patentee says, "I do not claim as my invention any of the above parts of the said machine, taken separately and without their connection

in said machine, or application to the purpose aforesaid." "But I do claim as my invention and improvement, the mode above substantially described, of mounting the working machinery and moving the same above the log or timber to be sawed in the manner aforesaid, or in any other manner substantially the same, so that the saw works through the log by its own travel, while the log is secured on stationary head stocks nearly on a level with the ground line."

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32. For a *Locomotive Steam Engine;* Asa Whitney, Rotterdam, Schenectady county, New York, June 27.

The engine is secured to a frame which rests on two four-wheeled carriages, there being trucks under the frame which rest on the top frame of each carriage. The wheels of each carriage are connected together by means of a crank on each end of the axles, and a connecting rod on each side, so that each carriage has four driving wheels, and the four wheels of each carriage are connected together so as to make a locomotive with eight driving wheels. This last connexion is effected by having a cog wheel on the hind axle of the front, and another on the fore axle of the back carriage, which wheels mash into a cog wheel on the crank shaft situated between the two. The cog wheels being in the middle of the axles, the slight vibration occasioned by passing around a curve will not materially affect the working of the cog wheels.

Claim.—"I do not claim any one of the parts of said engine, or locomotive, separately and independently of the arrangements and combinations herein set forth and claimed, nor any combination or combinations of the parts aforesaid, not herein specially named and claimed as my invention and improvement, but I do claim, in the first place, as my invention and improvement, the combination of the cog or spur wheel with the two pairs of driving wheels nearest to them, in combination with the rod connecting the front and rear wheels with the middle wheels, by which combination of the cog wheels and connecting rods with the driving wheels, the power of the engine is communicated to the whole number of the driving wheels, when the engine is put in motion." "I also claim the above method of connecting the wheels of the locomotive, so as to constitute four pair of driving wheels in combination with the frame extending over both carriages, resting on bearings, and supporting the weight of the engine on two separate carriages as herein set forth, thereby securing the adhesion to the rails of the whole eight wheels."

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33. For an improvement in the manner of *Constructing the Dies for Manufacturing Knobs for Locks, Drawers, Bell Pulls, and for other purposes;* Lucian E. Hicks, Middletown, Connecticut, June 27.

The above named patent is taken for an improved mode of making dies for manufacturing knobs, so that each knob shall be made of one single piece of plated metal. The knobs are to be formed, as usual, by means of two polished steel dies; but the lower die, instead of ending where the form of half the knob terminates, is continued up to

some height, cylindrically, and the outside of the upper die is also cylindrical, and fits into the cylindrical part of the under die. The hollow or cavity of the upper die, which forms one half of the knob, meets its cylindrical part at a perfect edge; after the metal has been raised so as to form one half of a knob, the part which is to constitute the other half being cylindrical, the piece thus prepared is placed within the lower die, into which it should fit exactly; then when the upper die is brought down upon it, the cylindrical portion of the plated metal will be thereby made to assume the desired form, and the knob be completed.

There are certain appendages to the lower die, which are referred to in the claim, but which we do not think it necessary particularly to explain; the main feature of the invention being that above set forth. The claim is to the forming of the cup of the lower die with cylindrical sides, and adapting the upper die thereto by forming its outside cylindrical, and of such size as to fit the lower dies, whilst the junction of its cylindrical sides, and its hollow or cup, constitutes a sharp edge in the manner and for the purpose described; and also the combining with the lower die, the bolt with its shoulder for the purpose of forming the hole in the knob and of raising it from the die.

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34. For improvements in the *Machine for Cleaning Feathers;* John H. Stevens, of the City of New York, Assignee of Robert B. Lewis, June 27.

The feathers are put into a perforated cylinder, the axis of which turns on a sliding frame, which frame slides in grooves made in the two opposite sides of an outer stationary cylinder. In the space left between the stationary cylinder and the inner perforated cylinder, pipes are arranged through which steam is to be conveyed. A pipe governed by a cock admits the steam to these pipes, or cuts it off at pleasure; at the bottom of the machine there is also a pipe for the discharge of the condensed water. The inner cylinder is provided with suitable doors to admit and remove the feathers. The claim is to the combination of the horizontal and circular pipes with the outer cylinder, together with the means of letting in and shutting off the steam. There are other claims made to the particular manner of arranging certain parts, not easily described, and, as we think, not needing a very particular description. We do not see any thing in this apparatus which can render it superior to some of its predecessors, most of which have had their day, and are not now heard of.

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35. For a portable *Apparatus for Purifying Carburetted Hydrogen Gas, produced from wood,* for illumination; Daniel Garret, Richfield, Otsego county, New York, June 27.

This is a "portable apparatus for the purification of carburetted hydrogen gas, produced from wood, for the purpose of illumination, which apparatus is to be employed as an article of domestic economy, the gas being produced by the fires used in cooking stoves, or for

other purposes." Within a metallic cylinder, containing water, two condensing cylinders of metal are placed, side by side, the top of the outer cylinder serves to close the upper ends of the two condensing cylinders; the lower ends of these latter terminate within a short distance of the bottom of the outer cylinder; the water in the latter surrounds the condensing cylinders; cylinders of wood occupy a large portion of the interior of the condensing cylinders, and through perforations contained in one of these, the gas, generated in a retort, or vessel, exposed to the action of the fire within the stove, is to pass through a pipe. The space between the wooden, or metallic cylinder, receives the gas, and the pyrolignous vapour is, in part, condensed, and deposited in it; the gas passes thence into the next condenser, where its purification is to be completed. From this it is to pass through a pipe at the top, to the burner or burners; suitable pipes lead from the bottom of the condensers for the discharge of the condensed fluid, &c. The claim is to the manner in which the outer cylinder containing water, the condensing cylinders, and the inner cylinders have been arranged and combined for the purpose specified. The gas made by an apparatus of this kind may be used for a time, as a matter of amusement, but it will be defective in quality, troublesome to prepare, and without economy in use, and its fate, therefore, may be foretold.

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36. For a *Seed Planting Machine;* Thomas J. and George F. Lewis, Boston, Massachusetts, June 27.

This seed planter is one of the kind in which the seeds are received in holes made through the face of a wheel revolving horizontally, at the bottom of the hopper. A machine similar to this, except in some slight modifications to which the claim is confined, was patented to Martin and Samuel L. Seward, on the 27th of July, 1839, and is noticed in this journal, vol. xxvi, page 118. The claim to the proposed improvement could not be understood without a more full description than we think it necessary to give, and probably not without drawings.

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37. For improvements in the *Percussion and Re-action Water Wheel;* Zebulon Parker, of Newark, Licking county, Ohio, and Robert M'Kelvey, of Portage county, Ohio, Administrator of the late Austin Parker, deceased, June 27.

This patent has been obtained for improvements on a water wheel, patented by Zebulon and Austin Parker, on the 19th of October, 1829, and noticed in the 5th volume, page 33, of the new series of this journal.

"The percussion and re-action wheel, or wheels, whether on a horizontal or a vertical axis, or shaft, is enclosed in a box, or case, which is denominated a draft, which draft is made air and water-tight at the top and sides, but it is without a bottom, the mouth of said draft dipping into the water, and being, whenever the mill is running, below the level of the water in the tail race; its action in this case

will be like that of any air and water-tight box having one side open, and that side placed downwards, so that its edges shall dip into water; that is to say, if such box be filled with water, it will remain full, provided its altitude above the surface of the water be not greater than that of a column, which will be sustained by atmospheric pressure. The water which passes into these air-tight cases, or drafts, passes in through the percussion and re-action wheels. "What is claimed as new in the above described improvement on the percussion and re-action water wheel, as originally patented by Z. and A. Parker, is the placing of the said wheel, or wheels, or of wheels analogous thereto in their construction and mode of operation, within air and water-tight cases, or boxes, herein denominated drafts, substantially in the manner, and for the purpose above set forth."

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38. For an improvement on the *Screw Wrench;* Henry W. Hewet, New York City, June 27.

On the main bar between the handle and the fixed jaw is placed a revolving tube, one end being made octagonal, by which it is turned, and the remainder having a male screw cut upon it, which fits into a nut attached to the movable jaw. As the tube is turned to the right or left, the movable jaw is moved towards, or from, the fixed jaw.

The claim is confined to the cutting of the male screw upon the tube which revolves upon the main bar, in combination with the nut attached to the movable jaw.

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39. For a machine for *Breaking Stone, employed in making Roads, &c.;* Nicholas Cooper, Sr., Townsend M'Connel, and William E. Lukens, the two former of Wheeling, Ohio, and the latter of Short Creek, Harrison county, Ohio, June 27.

A revolving cylinder has around its periphery a series of hammers, either fixed or swinging; and these hammers, as the cylinder revolves, pass between a series of short bars standing at right angles to it, and having their ends nearly in contact with it; they extend out in a line nearly horizontal with its axis, and embrace, by their depth, about one-fourth of its circumference.

The stones to be broken, are thrown into a hopper, whence they pass down an inclined plane, and come into contact with the revolving hammers, by which they are beaten, and are made to fly upwards, against what the patentees denominate a battery, from which they rebound, and are again struck by the hammers; and this continues until they are reduced to a size which will admit of their falling through the grating.

The claim is confined to the combination of the rotary hammers, fixed, or swinging, with the bars, and the combination of these with the grating and the battery.

Various attempts have been made to break stone for the making of roads, by means of machinery, but we are not aware that any such machine has been continued in use; should that before us be destined

to establish its character for usefulness, it will do more than we expect from it.

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40. For improvements in the *Seed Planter;* Thomas J. and George F. Lewis, Boston, Massachusetts, June 27.

This patent is for improvements on the kind of seed planters in which the seed is distributed and dropped by apertures in a horizontal wheel placed at the bottom of the hopper, like that above noticed as having been patented by the same persons, and bearing the same date with that now under consideration. The modifications claimed under this patent, consist in the peculiar arrangements of the hopper and of the dropping apertures in the wheel, and likewise in the mode of arranging the gearing by which the parts are operated. As the claims refer to, and could not be understood without the drawings thereof, we omit them.

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41. For an improved method of *Hydrographic and Topographic Surveying;* H. Ariel Norris, City of New York, June 27.

We will merely quote from the specification those portions of it in which the patentee expresses the nature of his invention, and what he claims as new, viz: "The nature of my invention consists in a greatly facilitated system of triangulation; the angles being measured from the extremities of one or more base lines to a moving flag, (or other mark,) simultaneously, and at regular intervals of time; one chronometer (or other time-keeper,) governing the measurement of angles upon the base lines, and another, set to the first, governing the soundings and other examinations of the party accompanying the moving flag, on land, or on water." "What I claim as my invention, and desire to secure by letters patent, is as follows. 1st. The method herein described of enabling the bearing angles of the boat, or moving body, to be taken, at the same instant, from the extremities of one or more base lines, by the use of time-keepers and signals, arranged and operated upon the principles herein set forth—the principal object of which arrangement is to determine the boat, or moving body's position without stopping its progress, thus executing the survey more rapidly. 2nd. In combination with the foregoing, the method herein described of enabling the soundings (or other notices and examinations of the surveyor accompanying the moving body,) to be made at the same instant the angles are taken, by the employment of a time-keeper, for ascertaining the times, previously agreed on, at which the soundings (or other examinations,) should be taken, and the angles measured."

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42. For a mode of *Sawing or Cutting Snags;* James Hamilton, New York City, June 27.

This patent is obtained for a mode of arranging a saw, and connecting it with the necessary machinery, placed in a boat, or scow; the saw is made capable of being placed at any desired inclination, to cut in any direction, and at any desired depth under water. Said

saw is attached to the end of an arm, which slides in a frame, and is actuated by a crank. The manner of arranging the respective parts cannot readily be described without drawings, and as the machine, should it prove to be useful, will not be one of general interest, we are not disposed to afford the space which would be required, were we to attempt the description. We are the less inclined to this, however, because we think that the machine will not prove to be one of utility; not from want of skill in the inventor, but from difficulties which are inherent, namely, the unavoidable mobility of the vessel within which the machinery must be placed. The claim is to the above arrangement by which the saw can be placed to cut at any inclination.

Specifications of American Patents.

Specification of a Patent for a Cooking Stove. Granted to William Gallup, *Norwalk, Huron county, Ohio, June 10th,* 1840.

To all whom it may concern: Be it known that I, William Gallup, of Norwalk, in the county of Huron, and State of Ohio, have invented an improvement in the manner of constructing cooking stoves. I do hereby declare that the following is a full and exact description thereof. [References to drawings have been omitted.]

The fire chamber is connected with the main body or oven part of the stove, by a flat flue, which extends the whole width of the stove, and slides back and forth, and is capable of being passed entirely into the upper portion, or flue, of the main body, or oven part of the stove, so as entirely to close the space formed by the front of the body of the stove, and the back of the fire-chamber, when it is drawn forward. The fire-chamber extends down, so as to rest and slide upon the bottom plate of the stove, and has openings, or grate bars, in front, and extending down on its lower side for the admission of air, as in the ordinary open grate, the ashes from which fall into the ash-pit, or sink, in the bottom plate. I make four boiler holes in the top plate of the sliding part of my stove, and the same number in the top plate of the main body, and these are so arranged as that when the front portion is slid in, its two rear holes will coincide with the two forward holes, in the top plate of the main body.

When the fore part is drawn out, there will be a space formed between the two portions, having on one side of it the back plate of the fire-chamber, on the other, the fore plate of the oven flue, and at the top, the flue, by which arrangements this space is admirably adapted to the purpose of roasting, heating, and other cooking operations, and is intended to receive a tin, or other roaster, of any convenient form. The oven in the main body of the stove is surrounded by flues at four of its sides, the draught passing over a plate extending from the throat over the oven around the end of this plate, between it and the top of the oven, down the front of the oven, under the oven, and up the

back. There is a damper to open a direct communication from the fire-chamber to the exit pipe, when desired, as in many other stoves.

Having thus fully described the construction, and the mode of using, my stove, what I claim therein as of my invention, and desire to secure by letters patent, is the forming of a baking compartment between the back plate of the fire-chamber and the front plate of the main body of the stove, by arranging the oven below the throat of the furnace, in the manner described, instead of above it, as heretofore, by which means a radiating surface is presented at the back of the compartment.

WILLIAM GALLUP.

Specification of a Patent for Ponton Equipage, for the use of Armies. Granted to E. M. HUNTINGTON, *Terre Haute, Indiana, Administrator of the Inventor,* JOHN F. LANE, *deceased, late Colonel in the Army of the United States, June* 17*th*, 1840.

To all whom it may concern: Be it known that John Foote Lane, late a Colonel in the Army of the United States, of the State of Indiana, now deceased, did, during his life time, invent a new and useful ponton equipage, or apparatus, which equipage, or apparatus, is intended, principally, for the purpose of constructing ponton bridges for the use of armies, and which is also serviceable in the formation of floating batteries and rafts, and for other purposes in military operations. And I, Elisha Mills Huntington, administrator of the estate of the late decedent, do hereby declare that the following is a full and exact description of the said ponton equipage, or apparatus.

Instead of the boats ordinarily employed in the construction of ponton bridges, pontons, or floats, are made of stout sail duck, or other suitable material, which is rendered impervious to air and moisture, by being coated, or saturated, with India rubber, or in any other adequate manner. The material used is to be made into pontons, or floats, of such size as may be considered necessary to adapt them to the particular purpose to which they are to be applied. That which has been most used is in the form of a cylinder, of about eighteen feet in length, and two feet in diameter, when inflated, or filled with air. Although these pontons, or floats, may be made, or constructed, in different modes, that which has been found most eligible, as uniting strength with convenience, is the following. They have been made of three thicknesses of stuff; the interior, or lining, and also the second layer of material, has been of Russia sheeting, of the best quality; and No. 1 Russia twine duck, (hemp,) or some other equally good fabric, has been used for the outer layer. Each of these layers has been coated with the prepared India rubber, applied thereto by the proper machinery, in such way as completely to saturate it. In forming the ponton, the inner, or lining, thickness of duck is put together with the side on which the India rubber is applied, outwards; the stuff should be so cut as that the ends shall be hemispherical. The joinings are secured by means of strips of the same material coated with India

rubber on both sides; these strips should be about five inches wide. At one end, or at both ends of this, a flexible air-tube, or piping, is to be inserted, through which the ponton is to be inflated. The ends of these tubes are furnished with metallic terminations, having suitable caps, or valves, for the proper management of the inflating process. The second layer of material is now to be applied on the first, and this is prepared by being coated perfectly on both sides with India rubber. In applying this, care is taken to break joints, and to connect it with, and along, the air, or inflating, tube, leading into the interior. The third, or outer layer of material, is then put on; this is covered with India rubber on that side only which is in contact with the second layer, but this material is so applied to it as to be driven well through its fibres; this also is attached to, and covers, the air-tube.

For the purpose of making the requisite attachment to the pontons, they are to be embraced, both longitudinally and transversely, by strong bands of the same, or other suitable material, which bands, at the ends and sides of the pontons, are to be formed into loops, in the manner hereinafter shown. These bands have been made six inches wide, and like the pontons, of three thicknesses of stuff. There may be two bands made to run longitudinally, and these are formed into loops at each end of the ponton; and five such bands have been made to surround them. The loops left on each side of the pontons may measure about a foot. These loops should be stitched with strong twine, or thread, close to the pontons, so as to render them secure against the strain to which they will be subject. All this having been properly done, the pontons are ready for inflation at any time, which may be effected by the common Smith's bellows, or by a suitable force or condensing pump.

To form a bridge over a stream with these pontons, having provided the requisite string-pieces and plank, first inflate a sufficient number of the pontons, then place one of them in the water, parallel with the bank of the stream, and by three string-pieces, so that their outer ends reach the centre of the ponton; then shove the ponton into the stream, the length of the string-pieces, which may be fourteen feet, more or less—place another ponton under the string-pieces next the shore, lay plank upon this section of the bridge, add the next set of string-pieces, connecting the string-pieces of the respective sections, by means of iron clasps, or by dovetails, or otherwise. Where the strength of the stream requires it, guy ropes must be attached to the ends of the pontons, and to the river bank, so as to keep the pontons in their proper places; and in this manner until the bridge reaches the opposite bank of the river. Any number of such pontons may be connected together, when requisite, so as to constitute a floating battery, or float, or raft, for the transportation of armies, baggage, or troops, instead of a bridge, this may be effected by placing them side by side, and passing poles through the loops, and then covering the whole with plank, or not, according to the nature of the service desired.

Other forms than that of the cylinder may, it is manifest, be given to the respective pontons. They have sometimes, for example, been

made in the form of an ordinary pillow, and two, three, or more of them have been connected together, so as that their greatest width were in a vertical direction, and thus confined together by loops and poles, or otherwise. Their ends, in this case, have been formed like the bow of a boat, or canoe, so that when made to constitute a float, or raft, their passage through the water has been smooth and easy. It will be evident that such pontons may be so constructed as to assume the form of a boat, or any other figure that may be found necessary or convenient, and they may be made of one, two, three, or more cylinders, attached. Where there is danger from the attack of an enemy, great security will result from the combining of two, three, or more, of such pontons, to support the ends of the string-pieces of a ponton bridge, as the perforation of one, or two, by balls, or otherwise, may still leave the structure sufficiently secure.

Having thus fully described the nature and object of the invention made by the late Colonel John Foote Lane, and shown the manner in which the same is to be used; what is claimed as new therein, is the constructing of ponton bridges, by combining together the pontons, such as herein described, and the necessary string-pieces and planking, as set forth, and also the combining together of such pontons as herein described, so as to form floating batteries, or floats, or rafts, for the conveyance of arms, or troops, or for other purposes, appertaining to military operations.

E. M. Huntington.

Specifications of English Patents.

Specification of a Patent granted to William Hickling Bennett, *of London, for Improved Machinery for Cutting and Working Wood. December 24th,* 1840.

The improvements comprehended in this patent are—Firstly, a new system of guides for boards while passing through the wood-cutting machines. The iron frame of the guides varies in shape in different machines; it forms a bed on which the guides traverse. The guides are formed of puppet-heads in pairs, one being fixed, the other movable, in order to hold and guide wood of different sizes. Movable pieces slide over the inner vertical faces of the guides, and pressing down upon the upper surface of the wood it is thus held firm and steady.

Secondly, an improved mode of elevating and depressing the upper pair of rollers, when the wood is carried forward by their means. The axes of the upper rollers turn in blocks which slide up and down in grooves in the upright side frames of the machines. They are regulated by spur and bevel wheels, in conjunction with spiral springs, so that while the wood is finally held, an elasticity is obtained by means of the springs, which allow any irregularities in the surface of wood to pass through the rollers.

Thirdly, an improved mode of admitting oil to the working parts,

viz: the circular saws, shafts, spindles, &c. consisting of a cup with a tube at the bottom furnished with a stop cock, to be so adjusted as to allow any number of drops per minute to fall from the nipple into the channel leading to the bearings requiring lubrication.

Fourthly, an improved mode of sawing and dividing wood, so as to effect the planing at the same time; the arrangement being also applicable to veneer saws.

For this purpose, there are slots near the periphery of the circular saws, approaching as near to the edge as is consistent with due strength; in these slots side cutters are fixed, with their edges ground and set to the same angle as a plane iron. These cutters project slightly beyond the set of teeth of the saw; so that a shaving is continually taken off as the saw revolves. Or the edges of such slots in the saw plate may be turned up and used in lieu of detached cutters.

Fifthly, the application of the foregoing construction with two or more sets of circular cutters, so as to form two or more strips of plain or ornamented moulding. To accomplish this, two or more circular saws are mounted on one spindle between which, instead of washers, blocks are fixed, holding the cutters in their upper edges. These are circular and may be either plain or moulded, and they project sufficiently to perform the necessary operation as rapidly as the circular saws can rip the scantlings or boards into strips.

Sixthly, an improved mode of forming moulding and other cutters. These cutters may be of any required shape, and are attached to blocks, fixed on the saw spindle by grooves and feathers. They are made of thin steel plates, screwed between two metal plates, which are worked down on each side so as to leave the steel edge projecting about $\frac{1}{20}$ of an inch.

Seventhly, a machine for preparing deals and haulks of timber for sawing. The wood to be operated upon is laid on a metal bed moved by a rack and pinion and slides on V pieces fixed to the floor. The apparatus for holding the timber is firmly secured to this bed; puppets are screwed to the sliding bed, their inner faces being made perfectly true. To these faces a cast-iron beam is attached vertically, so that it can be moved up and down, by nuts and screws, and serves to clip the upper part of the piece of timber.

The holding parts are capable of adjustment, so that timbers of any size may be held on different sides quite firmly, and brought up to the cutters by the traversing bed, for preparing a flat or square side thereto.

Eighthly, a machine for the same purpose, which may also be used for cutting mouldings or cornices and skirting-boards.

The wood in this case is secured to a traversing table and moved forward by a chain, rack and pinion, or other convenient means. Circular cutters are made to revolve above it, which strike the required pattern on the edge of the wood as it advances.

Ninthly, another machine for the same purpose, only in this case the machinery with the cutters approaches the wood instead of the wood approaching the cutters. This consists of a movable bed traver-

sing upon a fixed one; this bed carries the cutters with their driving wheels, &c. The wood is held upon a raising and falling table, while the machinery, cutters, &c. on the traversing bed are made to approach and perform the required operations on its surface and edges.

Specification of a Patent granted to FELIX TROUBAT, *for improvements in the Manufacture of Vinegar. February* 1, 1841.

To 350 lbs. of raw potatoes, well rasped, are added from 20 to 25 gallons of water and 2 lbs. of sulphuric acid; this mixture is to be boiled for six hours, and then run off into a cooler, through a perforated plate or strainer, to free the liquor from sediment, and afterwards transferred to another vessel placed in a chamber of a temperature of 80° of Fahrenheit. One ounce of potash dissolved in water, and half a bushel of yeast are added to the liquor; at the expiration of three days a further quantity of yeast is added to increase the fermentation. A vessel is loosely filled with shavings of beech, or the skins of pressed grapes saturated with strong vinegar. Three gallons of the fermented liquor are poured in, mornings and evenings, till the vessel is filled. It is then drawn off, three gallons at a time, from the bottom of the vessel, and poured into another vessel half filled with perfect vinegar, from which it is removed into another loosely filled with beech shavings to cool and clear it, which renders it fit for use. Another process consists in pouring 50 gallons of boiling water upon 350 lbs. of potatoes that háve been well crushed and washed, and allowing it to stand until it assumes the consistence of a thick paste, when half a bushel of meal of malt is added to bring it into a saccharine state; it is then submitted to the process of fermentation, &c., as before described.

In another process, 50 or 60 pounds of ground rice is used in lieu of the potatoes, and treated according to the directions first given. The patentee does not confine himself to any of these precise proportions, but claims, 1. The mode of making vinegar by the application of potatoes. 2. The mode of making vinegar by the application of rice as described.

LUNAR OCCULTATIONS FOR PHILADELPHIA, SEPTEMBER, 1841.
COMPUTED BY JOHN DOWNES.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.
☞For direct vision add 180°.☜

Day.	H'r.	Min.	Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	16	57	Im. λ Piscium,	5	102°	149°
1	17	59	Em.		319	9
6	11	14	Im. b Pleiadum,	4.5	80	25
6	12	4	Em.		323	266
6	11	15	Im. g Pleiadum,	5.6	119	64
6	12	14	Em.		284	227
6	11	38	Im. ε Pleiadum,	5	142	85
6	12	25	Em.		252	195
6	11	42	Im. c Pleiadum,	5	117	61
6	12	44	Em.		287	230
23	8	39	Im. χ' Sagittarii,	6	115	135
23	10	1	Em.		293	327
24	6	48	Im. 21 Capricorni,	6	135	112
24	8	14	Em.		285	280

Meteorological Observations for June, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	50	75	29.86	29.80	SW.	Moderate.		Cloudy—clear.
	2	57	83	.75	.75	W.	do.		Clear—do.
☺	3	62	78	.75	.82	W.	Brisk.		Clear—do.
	4	54	80	.88	.98	W.	Moderate.		Clear--do.
	5	60	91	.80	.75	W.	Brisk.		Clear—do.
	6	62	84	.90	.94	W.	do.		Clear—do.
	7	60	87	.90	.90	S.	Moderate.	.25	Cloudy—clear--shower.
	8	69	92	.80	.80	W.	do.		Clear—do.
	9	68	91	.80	.80	W.	do.		Clear--do.
	10	66	86	.80	.85	W.	do.		Clear—do.
	11	64	84	.76	.70	W.	Brisk.		Clear—do.
☽	12	70	77	.64	.70	NE.	Moderate.	.09	Cloudy—do.—rain.
	13	50	70	.76	.70	E.	do.		Cloudy—do.
	14	62	76	.70	.70	SW.	do.		Cloudy—do.
	15	66	75	.64	.74	NW.	do.	.09	Rain—clear.
	16	55	77	.80	.86	N.	do.		Clear—do.
	17	57	81	.94	.95	W. SE.	do.		Clear—do.
	18	61	62	.95	.95	E.	do.	1.20	Rain—do.
⊗	19	60	67	.84	.85	E. N.	do.		Cloudy—do.
	20	56	80	.85	.84	SW.	do.		Clear—do.
	21	62	70	30.00	30.05	E. SE.	Brisk.		Cloudy—do.
	22	63	66	.05	29 90	SE.	Moderate.	.15	Cloudy--rain.
	23	70	80	29.85	.80	S.	do.		Cloudy—do.
	24	70	86	.78	.78	SW.	do.		Cloudy—do.
☾	25	72	76	.80	.85	SE.	do.	.62	Cloudy—rain.
	26	72	81	.80	.80	W.	do.		Cloudy—flying clouds.
	27	73	80	.80	.80	SW.	do.		Cloudy—do.
	28	66	81	.85	.86	W.	do.		Clear—flying clouds.
	29	68	88	.90	.94	W.	do.		Clear—do.
	30	70	88	.90	.90	W.	Brisk.		Clear—do.
	Mean	63.17	79.73	29.83	29.83			1.131	

Thermometer.			Barometer.	
Maximum height during the month,	92 00	on the 8th.	30.05	on the 21st and 22d.
Minimum " "	50.00	" 1st and 13th.	29.64	" 12th and 15th.
Mean	71.45		29.83	" "

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	Cou	Mean.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Philadel	29.9	⅓	4⅓	5⅔	2⅓	.	.	....	.		....	.	1384
2	Montgom													
3	Bucks,	29.9	3⅔	1	8⅔	⅓	⅓	2	....	.	.....	....	.	1497
4	Lehigh,													
5	Northam													
6	Monroe	29.4	6⅔	.	2⅓	.	.	10⅔	....	.	.....	....	.	1391
7	Pike,													
8	Wayne,	28.6	1⅔	.	12⅔	.	⅓	.	....	.	......	....	.	1393
9	Susqueh	27.9	9⅓	.	7⅔	.	.	.	....	.	.....	....	.	1404
10	Luzerne,													
11	Schuylki	29.1	7	.	5⅓	.	8⅔	1⅔	....	.	.....	....	.	1394
12	Berks,	29.7	6⅓	.	16⅓	.	⅔	.	....	.	......	....	.	1382
13	Chester,	29.8	1	2⅓	9	1⅔	1	⅔	....	.	.....	....	.	1385
14	Delaware	29.4	⅓	2	10⅔	3⅔	⅔	1⅓	14.89	1	.....	....	.	1399
15	Lancaste	29.3	4⅓	1⅔	3⅔	2	.	.	22.71	.	......	32.14	.	1414
16	York,													
17	Lebanon													
18	Dauphin	29.6	.	.	18⅓	.	.	⅔	....	.	.....	....	.	138[illegible]
19	Northum	29.2	7⅓	⅓	3	.	2	.	....	.	.....	....	.	1386
20	Columbi													
21	Bradford													
22	Tioga,													
23	Lycomin													
24	Union,													
25	Mifflin,													
26	Juniata,	29.3	1⅔	.	7⅔	.	12	1	....	.	.....	....	.	1387
27	Perry,													
28	Cumberl													
29	Adams,	29.3	6⅓	1⅔	2	.	6	2	17.99	3	.....	30.30	3	1437
30	Franklin													
31	Hunting	29.1	20⅔	.	.	.	.	.	....	.	....	....	.	1398
32	Centre,								....	.	.....	....	.	
33	Potter,													
34	M'Kean,	....	6	.	4⅔	.	.	1	....	.	.....	....	.	1402
35	Clearfiel													
36	Cambria	27.6	7	.	7⅔	.	4	⅓	....	.	.....	...	.	1390
37	Bedford,	29.0	⅔	4⅔	6⅓	.	.	.	....	.	.. .	....	.	13[illegible]8
38	Somerse	27.6	8	2	⅔	.	8	3⅓	....	.	.....	....	.	1392
39	Indiana,	28.4	10	.	5	.	⅔	2	....	.	...	....	.	1401
40	Jefferson													
41	Warren,	28.5	6	.	6	.	4⅓	.	....	.	......	....	.	1397
42	Venango	28.7	.	.	20	.	.	1⅓	....	.	.....	....	.	1396
43	Armstro													
44	Westmo													
45	Fayette,	28.9	7	.	8	.	⅔	.	....	.	.....	....	.	1443
46	Green,													
47	Washing													
48	Alleghan	29.0	3⅔	.	8	.	7⅔	1⅔	....	.	.....	....	.	1400
49	Beaver,	29.2	.	.	17⅓	.	2⅔	2	....	.	......	....	.	14[illegible]8
50	Butler,	28.6	3	.	2	.	.	.	....	.	.....	....	.	1389
51	Mercer,													
52	Crawford													
53	Erie,													

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Compiled from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

FEBRUARY, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.
1 Philadelphia, .	Philadelphia, .	G. P. Schively, .	30.93	36.75	30.68	52.50	4.50	32.79	.	3.00	27.93	.	29.98	29.98	29.97	30.33	29.45	29.98	.
2 Montgomery, .																			
3 Bucks, .	Newtown, .	L. H. Parsons, .	24.10	35.13	26.84	49.00	2.00	28.69	.	1.75	21.40	.	29.95	29.94	29.96	30.35	29.43	29.95	.
4 Lehigh, .																			
5 Northampton.	Easton, .	Charles Elliot, .																	
6 Monroe .	Stroudsburg, .	A. M. Stokes, .	15.04	32.83	17.50	44.00	—11.00	18.46	13⅓	....	....	.	29.39	29.44	29.48	29.70	29.10	29.42	8⅔
7 Pike. .	Milford.	Ralph Bull, .																	
8 Wayne, .	Hone dale, .	W. Richardson, .	14.36	29.43	16.54	46.00	—8.00	20.22	.	—20.00	8.86	.	28.66	28.65	28.66	29.00	28.25	28.66	.
9 Susquehanna, .	Silver Lake, .	E. Rose, .	19.89	28.07	24.04	50.00	—2.00	24.33	.	....	....	.	27.99	27.98	27.98	28.36	27.52	27.98	.
10 Luzerne, .	Wilkesbarre, .	W. F. Dennis, .																	
11 Schuylkill, .	Port Carbon .	P. C. Lyceum, .	17.79	38.57	21.80	52.00	—13.00	26.05	.	—15.00	12.25	.	29.19	29.19	29.15	29.86	28.21	29.18	.
12 Berks, .	Reading, .	C. F. Egelmann, .	21.94	32.75	25.07	46.00	00.00	26.59	.	—4.00	17.80	.	29.70	29.68	29.71	30.1[illegible]	29.20	29.70	.
13 Chester. .	West Chester,	Wm. W. Jefferies, .	....	....	....	....	....	....	.	00.00	22.97	.	29.80	29.80	29.80	30.07	29.44	29.80	.
14 Delaware, .	Haverford, .	Haverford School, .	29.86	36.73	32.64	49.00	14.00	33.08	6	00.00	20.37	.	29.43	29.38	29.41	29.76	28.92	29.41	.
15 Lancaster, .	Lancaster, .	Conservatory of Arts,	24.68	36.39	27.16	54.00	3.00	29.41	.	2.00	22.43	.	29.32	29.29	29.32	29.73	28.79	29.31	.
16 York, .																			
17 Lebanon, .																			
18 Dauphin. .	Harrisburg, .	J. Heiseley, .	25.04	31.44	29.63	44.00	5.00	28.70	⅔	5.00	22.14	.	29.69	29.65	29.70	30.07	29.22	29.68	⅔
19 Northumberland.	Northumberland,	Andrew C. Huston,	19.00	34.39	24.18	52.00	—9.00	25.86	.	—13.00	13.68	.	29.30	29.26	29.30	29.65	28.75	29.29	.
20 Columbia, .	Danville,	C. H. Frick.																	
21 Bradford, .																			
22 Tioga, .																			
23 Lycoming, .																			
24 Union, .																			
25 Mifflin, .																			
26 Juniata, .	Mifflintown, .	J. A. Kinkead, .	18.79	35.88	22.80	50.00	00.00	25.82	1⅓	....	....	.	29.34	29.36	29.34	29.76	28.82	29.35	1⅓
27 Perry, .																			
28 Cumberland, .	Carlisle, .	Prof. W. H. Allen,																	
29 Adams, .	Gettysburg, .	Prof. M. Jacobs, .	21.93	35.07	56.69	50.00	—4.50	27.56	.	—4.50	19.16	.	29.33	29.34	29.33	29.56	28.78	29.33	1⅓
30 Franklin. .																			
31 Huntingdon, .	Huntingdon, .	Prof. Jacob Miller,	19.88	36.00	24.71	49.00	—13.00	26.86	.	....	....	.	29.18	29.16	29.18	29.56	28.68	29.17	.
32 Centre, .	Bellefonte, .	John Harris, .																	
33 Potter, .																			
34 M'Kean, .	Smithport, .	M. R. Atkins, .	17.63	27.19	20.82	40.00	—10.00	21.88	⅔	....	....	.	....	....	....	....	....	....	.
35 Clearfield, .																			
36 Cambria, .	Ebensburgh,	Richard Lewis, .	18.21	28.59	21.29	43.00	—7.00	22.70	⅓	...	...	.	27.62	27.63	27.63	28.0[illegible]	27.23	27.63	⅓
37 Bedford. .	Bedford, .	Samuel Brown, .	22.38	35.83	26.61	49.00	00.00	28.27	.	....	....	.	29.05	29.04	29.06	29.00	28.00	29.05	.
38 Somerset, .	Somerset, .	George Mowry, .	22.94	31.54	25.76	45.00	2.00	26.75	3⅓	1.00	18.16	3	27.67	27.68	27.69	28.01	27.30	27.68	3⅓
39 Indiana, .	Indiana, .	Richard White, .	26.31	32.88	24.04	47.00	—8.00	27.74	2	....	....	.	28.40	28.45	28.42	28.80	28.40	28.42	2
40 Jefferson, .	Rose Cottage,	C. C. Gaskell, .																	
41 Warren, .	Warren, .	J. E. King, .	27.79	35.89	22.47	59.00	1.00	28.72	.	....	....	.	28.52	28.61	28.54	28.97	28.10	28.56	.
42 Venango, .	Franklin, .	Wm. Connely, .	16.00	33.32	23.25	47.00	—4.00	24.19	.	....	....	.	28.78	28.79	28.81	29.20	28.00	28.79	1⅓
43 Armstrong, .																			
44 Westmoreland,																			
45 Fayette, .	Uniontown, .	J. P. Weethee, .	25.93	34.86	27.86	49.00	4.00	29.55	.	....	....	.	28.90	28.91	28.88	29.24	28.34	28.90	.
46 Green. .																			
47 Washington, .	Cannonsburg,	Prof. A. H. Campbell,																	
48 Allegany, .	Pittsburgh, .	J. P. Bakewell, .	26.35	34.20	29.54	52.00	6.00	26.70	6⅔	....	....	.	29.10	29.07	29.11	29.50	28.55	29.09	.
49 Beaver, .	Beaver, .	James Allison, .	23.63	33.44	26.31	50.00	5.00	27.79	2	....	....	.	29.20	29.21	29.24	29.00	28.[illegible]0	29.22	2
50 Butler, .	Butler, .	Jacob Mechling, .	25.79	33.21	30.86	47.00	4.00	29.95	.	....	....	.	28.62	28.63	28.63	28.90	28.20	28.63	.
51 Mercer, .	West Greenfield,	S. Campbell, .																	
52 Crawford, .	Meadville, .	J. Limber, .																	
53 Erie. .	Erie, .	Park & Reid, .																	

County.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia	15⅓	12⅔	.	....	....	....	..	......	1	2	3⅓	⅓	.	.	⅔	.	⅔	.	5⅔	1⅔	⅓	4⅓	5⅔	2⅓	.	.	....	.		....	.	[illegible]
2 Montgomery																																
3 Bucks	10⅓	16⅔	1	2	2	....	..	1.308	1⅓	⅔	4⅓	.	.	.	.	⅓	⅓	.	4⅓	⅔	3⅔	1	8⅔	⅓	⅓	2	....	.	.....	....	.	1497
4 Lehigh																																
5 Northampton																																
6 Monroe	5	11	12	....	....	....	..	......	1⅓	.	1⅔	.	1	.	.	.	.	.	4	.	6⅔	.	2⅓	.	.	10⅔	....	.	.....	....	.	1391
7 Pike																																
8 Wayne	19⅓	8⅔	.	....	....	....	..	......	5⅔	.	4⅔	.	1⅓	.	1	.	⅔	.	.	.	1⅔	.	12⅔	.	⅓	.	....	.	.....	....	.	[illegible]
9 Susquehanna	7⅓	20⅔	.	1	6	....	..	0.687	4	.	.	.	.	.	.	.	3	.	4	.	9⅓	.	7⅔	.	.	.	....	.	.....	....	.	1404
10 Luzerne																																
11 Schuylkill	13	15	.	....	3	....	..	1.042	⅓	.	1	.	1⅓	.	1	.	.	.	1⅔	.	7	.	5⅓	.	8⅔	1⅔	....	.	.....	....	.	1394
12 Berks	12⅓	15⅔	.	....	2	1	..	0.525	.	.	1	.	1⅔	.	⅓	.	.	.	1⅓	.	6⅓	.	16⅓	.	⅔	.	....	.	.....	....	.	[illegible]
13 Chester	15	13	.	....	....	....	..	......	4⅓	⅓	2	.	1⅔	.	.	.	1⅓	⅓	1⅔	⅓	1	2⅓	9	1⅔	1	⅔	....	.	.....	....	.	[illegible]
14 Delaware	1⅓	17⅔	.	5	....	....	..	1.545	⅓	2⅓	2	.	⅓	.	.	.	.	.	3⅔	⅔	⅓	2	10⅔	3⅔	⅔	1⅓	14.89	1	.....	....	.	[illegible]
15 Lancaster	15	13	.	1	5	1	1	1.15[illegible]	1⅔	1	3	⅔	⅓	.	1	.	1	1⅓	4⅔	1⅔	4⅓	1⅔	3⅔	2	.	.	22.71	.	.....	32.14	.	1414
16 York																																
17 Lebanon																																
18 Dauphin	.	.	.	....	3	....	..	.....	.	.	⅔	.	1⅓	.	7	.	.	.	.	.	.	.	18⅓	.	.	⅔	....	.	.....	....	.	[illegible]
19 Northumberland	8⅔	19⅓	.	1	6	1	..	1.267	1⅔	.	5⅓	.	3	.	2	⅓	2	.	1	.	7⅓	⅓	3	.	2	.	....	.	.....	....	.	1386
20 Columbia																																
21 Bradford																																
22 Tioga																																
23 Lycoming																																
24 Union																																
25 Mifflin																																
26 Juniata	8⅓	18	1⅔	....	....	....	..	......	1	.	1⅔	.	⅔	.	⅔	.	.	.	1⅔	.	1⅔	.	7⅔	.	12	1	....	.	....	....	.	1387
27 Perry																																
28 Cumberland																																
29 Adams	13	13	1⅓	....	4	2	1	1.453	1	⅔	2⅔	⅓	.	⅓	1⅔	.	.	⅔	2⅓	⅓	6⅓	1⅔	2	.	6	2	17.99	3	.....	30.30	3	1437
30 Franklin																																
31 Huntingdon	16	12	.	....	2	....	..	0.917	.	.	.	.	7⅓	.	.	.	.	.	.	.	20⅔	.	.	.	.	.	....	.	....	....	.	1398
32 Centre																											....	.	.....	....	.	
33 Potter																																
34 M'Kean	11	16⅓	⅔	....	10	....	..	0.958	3⅔	.	2⅓	.	⅔	.	1⅓	.	⅔	.	7⅔	.	6	.	4⅔	.	.	1	....	.	.....	....	.	1402
35 Clearfield																																
36 Cambria	7	19⅓	1⅔	....	....	....	..	......	⅔	.	⅓	.	⅓	.	1⅓	.	.	.	6⅓	.	7	.	7⅔	.	4	⅓	....	.	.....	...	.	1390
37 Bedford	9⅓	18⅔	.	....	....	....	..	......	.	.	.	.	.	.	3⅓	.	.	⅓	4⅓	8⅓	⅔	4⅔	6⅓	.	.	.	....	.	.....	....	.	[illegible]
38 Somerset	8	16⅔	3⅓	1	3	....	..	1.000	.	.	⅔	.	.	.	⅔	.	⅔	.	1⅔	2⅓	8	2	⅔	.	8	3⅓	....	.	....	....	.	1392
39 Indiana	11	15	2	1	10	....	..	0.664	2	.	.	.	.	.	2	.	.	.	6⅓	.	10	.	5	.	⅔	2	....	.	...	....	.	1401
40 Jefferson																																
41 Warren	4⅓	23⅔	.	....	....	....	..	......	.	.	.	.	.	.	⅔	.	3	.	8	.	6	.	6	.	4⅓	.	....	.	......	....	.	1397
42 Venango	7	19⅔	1⅓	....	3	....	..	0.500	.	.	.	.	.	.	6⅓	.	.	.	⅓	.	.	.	20	.	.	1⅓	....	.	....	....	.	1396
43 Armstrong																																
44 Westmoreland																																
45 Fayette	13	15	.	3	4	....	1	1.312	.	.	1⅓	.	.	.	⅓	.	.	.	10⅔	.	7	.	8	.	⅔	.	....	.	.....	....	.	1443
46 Green																																
47 Washington																																
48 Allegany	11	15⅓	1⅔	....	1	2	..	1.119	⅓	.	.	.	.	⅔	2⅔	.	1⅔	1	⅔	⅓	3⅔	.	8	.	7⅔	1⅔	....	.	.....	....	.	1400
49 Beaver	8⅓	17⅔	2	2	2	....	..	2.465	⅓	.	.	.	⅓	.	1	.	⅓	.	4	.	.	.	17⅓	.	2⅔	2	....	.	......	....	.	[illegible]
50 Butler	13	15	.	....	6	....	..	0.833	.	.	⅓	.	5⅔	.	⅔	.	⅓	.	16	.	3	.	2	.	.	.	....	.	.....	....	.	1389
51 Mercer																																
52 Crawford																																
53 Erie																																

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OF THE

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AND

MECHANICS' REGISTER.

SEPTEMBER, 1841.

Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[CONTINUED FROM PAGE 23.]

Book 2nd.—Geomorphy.

Geomorphy, more commonly called Geodesy, is the science which treats of the measurement of the earth, and its great territorial divisions. The results in geomorphy are obtained by observations and calculations. Therefore, as a preliminary step, it is necessary to be made acquainted with the instruments which are used, and the formulas applicable to the observations made with them.

For this reason, we shall commence by giving the theory of these formulas, and a brief description of two instruments with which the observations are usually made. The theory of these formulas, which are of constant application, is comprised in the article on *spherical trigonometry.*

Operations in geomorphy consist in the measurement and calculation of angles and distances on the surface of the earth, and in the observation of stars, to determine from them the relative position of places. Hence the two great divisions of the subject into *terrestrial* and *astronomical geomorphy.*

The terrestrial operations consist in covering the whole ground to be explored with a series of triangles, the angles of which are measured with an instrument, and the sides calculated; one of the sides

being taken as a *base,* and measured by direct means. After this is done, we can derive from it the extent of the terrestrial arcs which lie within these triangles, such as the *meridian,* and the *parallel of latitude.* These arcs being known, serve to determine the ellipsoidal form, and the dimensions, &c., of the terrestrial globe.

The astronomical operations enable us to find the *longitude* and *latitude* of stations, the *azimuth* of the sides of triangles, the variation of the needle, &c.

Many other subjects are treated of in this book besides those enumerated, which are immediately applicable to geodesic operations. Some of which are—

1st. The oscillations of the *pendulum,* which furnish very useful data in determining the oblate form of the earth.

2nd. The elevation of points which are taken as geodesic stations, or in other words, the method of *leveling.*

3rd. The art of representing by figures the results arrived at by the foregoing methods; that is to say, the art of composing a *geographical map,* which enables the eye to embrace, and compare, at the same time, all the details; for it is not sufficient for the purposes of geography, to have merely the numerical values deduced from the determination of the sides of the triangles with which we cover a district of country to be surveyed.

Chapter II.—*The Repeating Circle.*

The repeating circle gives results with great precision, and is the most ingenious of all the instruments used in measuring angles. Since its invention by Borda, the large instruments used for terrestrial and celestial observations, the weight of which rendered their transportation and management so difficult, have been abandoned. Experience has shown that results can be obtained quite as accurately, and with much more rapidity, with a repeating circle of about three decimetres, [11.8113 inches,] in diameter. Figures 58 and 59 are representations of this useful instrument. In describing it, we limit ourselves to essential details; for the component parts are too complicated to be represented precisely by drawings. An examination of the instrument itself is the most satisfactory means of obtaining a knowledge of it.

We will give first the principles upon which the construction of the repeating circle is based.

93. It is a circle mounted on a tripod with a universal joint, by which it can be adjusted in the plane of any two objects between which it is proposed to find the angular distance, that is to say, the angle formed by visual rays drawn from the centre of the circle to

these objects. This circle turns on an axis perpendicular to its plane, and passing through its centre; so that in every position it takes in revolving about this axis, the objects, or signals, will be in the prolongation of the radii of the circle. This circle carries two telescopes movable around its centre; one of them, A A′, (figs. 58 and 59,) above the limb, and the other, B B′, below it.

The telescope A A′, can be directed to any one object in the plane of the limb, and the telescope B B′, to any other in the same plane, without moving the limb; the tubes of both telescopes revolving around its centre. It follows also that the circle, or limb, can revolve about the same axis, carrying with it the two telescopes. Each of these three movements is provided with a clamp and a tangent screw.

The construction of the telescopes will be described hereafter; for the present, it is sufficient to say that they are made with a magnifying power as great as the dimensions of the instrument will admit, and that in looking into the telescope we see two very fine threads intersecting each other at right angles, one parallel, and the other perpendicular, to the plane of the limb, with the point of intersection in the axis. To make an observation with the telescope, it is moved until the object is found in the optical field; this done, the delicate movements are produced, and the intersection of the threads brought in coincidence with the object by means of the tangent screw.

94. The limb is divided into degrees, half degrees, or less, according to the diameter of the instrument; usually, it is divided into divisions as small as five minutes. The upper telescope A A′, has a vernier attached to it, which slides along in contact with the divisions of the limb. This vernier enables the observer, by the aid of a magnifying glass, to read the fractional parts of a division.

The theory of the vernier was explained in article No. 9; it was there shown that when an arc of the vernier, equal to $n - 1$ parts of the limb, was divided into n number of equal parts, the space occupied by each division of the vernier was smaller than those of the limb by the nth part of the divisions on the latter. If, for example, the limb is divided into 360 degrees, and each degree divided into six equal parts, each part will be 10 minutes. If an arc of the vernier, equal to 59 of these divisions, be divided into 60 equal parts, each division of the vernier will be $\frac{1}{60}$ or 10″ smaller than those of the limb, and consequently the limb can be read to 10″.

95. The upper telescope being placed in any position whatever, if we wish to read the corresponding graduation, we commence by reading the number of degrees, and the divisions of tens of minutes; then, if the zero point of the vernier falls between two divisional lines

on the limb, (as frequently happens,) there remains to be read on th vernier the fraction corresponding to the interval between the zer point of the vernier and the preceding divisional line of the limb. Fo this purpose, we observe what divisional lines of the vernier and th limb are in exact coincidence; then counting the number of division from this point to the zero point of the vernier, the number so obtained, multiplied by 10,″ will be the fraction required. To save th trouble of counting, these divisions are numbered, so that the numbe of minutes and seconds to be added to the first reading are indicate on the vernier.

The lower telescope does not move in contact with the divisiona lines of the limb, and does not carry a vernier; its use will soon be explained.

96. The circle being mounted on the stand, and the limb being in the plane of the two signals, we fix the upper telescope on the zero of the graduation of the limb, and turn the circle upon the axis which is perpendicular to it, until the point of intersection of the cross hairs in the telescope A A′, is in coincidence with one of the signals L, (fig. 61.) The telescope is still fixed on the zero point of the limb. Fixing the limb in this position, direct the lower telescope upon the other object, K, to the left. The angle A C B, formed by the optical axes of the telescopes, is evidently the angle formed by visual rays from the centre of the circle to the two objects. This angle is measured by the arc A B of the circle intercepted by these two rays. But the telescope B B′, being below the limb, we cannot read the graduation.

Then turn the circle, and with it the telescopes, until the lower telescope, which was directed on the object K, situated to the left, takes the direction C A, on the object L, to the right; the upper telescope will thus be made to take the position C D, and the zero of the graduation on the limb will be moved from A to D. The value of the arc D A = A B, is the result required.

The circle being in the position last described, clamp it; then unclamp the upper telescope, and direct it on the object K, to the left. The angle B C A = A C D, is the one required; but the angle D A B, which we read on the limb, is double the required angle, it is therefore divided by two.

Repeat this double observation, by taking the point B, on the limb, as the point of departure, that is to say, turn the circle, together with the telescopes, until the upper one, which was in the position B B′, takes the position A A′, on the line of the right hand object; the zero of the graduation is thus moved from D to E, and the lower telescope passes from C A to C D. Now detach the lower telescope, and turn it (the limb being clamped,) until it is brought back on the object K,

to the left, and the arc E B, will be triple the arc A B. Repeat again the same operation, by clamping the telescopes, and turning the limb until the lower telescope is directed on the object L; the zero of the graduation is thus removed to F. Then detach, in its turn, the upper telescope, which is at C D, and move it until it is directed on the object K, to the left, and the arc F B, read on the limb, will be quadruple the arc required.

If we go on in the same manner, and make ten observations, the angle will be decupled. There is no necessity for reading the graduation at every observation with the upper telescope; it is sufficient to read the arc obtained when all the observations are completed.

We will now examine the advantages of measuring angles in this manner.

97. It is evident that if the upper telescope is brought back to the zero point of the graduation after ten observations, the sum of all the arcs is 360°, and each arc is 36°, and that the result is exempt from errors of eccentricity in the movement of the telescopes, and the errors in the division of the limb. It is proper to add that it seldom, if ever, happens in practice, that the upper telescope returns exactly to the zero point of the graduation; but if we find, after making ten observations, that the arc decupled is made 320° by some error of the instrument, when it should have been 320° 5′, we see that by dividing by 10, we get 32° instead of 32° 0′ 30″, and that the error is reduced from 5′ to 30″.

98. The repeating circle, when used with care and skill, has then this great advantage, that it diminishes the errors resulting from imperfection in the construction of the instrument, almost indefinitely. Besides, it lessens the errors resulting from not placing the cross threads and signals in coincidence.

To remedy the errors of eccentricity in the axis, it is customary to have two verniers attached to the superior telescope, diametrically opposite each other. The graduation of the limb corresponding to both verniers is read before commencing the observations, and after finishing them, for the purpose of seeing what space is passed over by the telescope; these arcs, if not exactly equal, will be nearly so, and the mean between them is taken. In the best instruments of this description, four verniers are used, placed at right angles to each other, and divided to read arcs of 5″ with exactness.

99. After what has been said, it is easy to form an idea of the construction of the repeating circle, (fig. 59.) The column S, is made with a slightly conical cavity in its longitudinal direction, in which the central axis of the instrument is inserted. This axis is of steel, and is firmly attached to a graduated circle, or plate, O. The column S

carries with it the circle M M, which, with its telescopes, turns about this steel axis, its motion being stopped by the clamp screw O, which clamps the arm attached to the column S, to the lower plate O. The angular value of the general movement of the instrument about the axis can be read on this plate. The column should be adjusted exactly upon the axis of the central shaft, in order that the movement may be smooth and exact.

The plate carrying the axis is supported by three screws, v v' v'', which rest on the table N N. These screws are used to give slight inclinations to the column S. The table N N, is supported by three stout wooden legs, and in a prismatic opening in its centre a rod of the same shape is fitted, by raising or lowering which the table is raised or lowered to a convenient height to suit the observer. The circle is supported on the top of the column S, by an axis V, around which it revolves. This motion about the axis is stopped by a clamp screw P, which presses against a piece of brass in the shape of the quadrant of a circle, embracing the axis V.

To place the limb in the plane of two objects, the movement given to the column by the screws v v' v'', is combined with the movement of the circle about the axis V.

Some of these instruments are constructed with two axes perpendicular to each other, about both of which the circle may turn. The circle is easily placed in the plane of two objects by a combination of these two movements. In this construction, the column S, remains upright.

The vernier is usually attached to a circle carrying the telescope, and concentric with the graduated limb. This circle and the limb are apparently united. The faces of both are in contact, and in the same plane, and turn about the same centre. Each circle is supported on the axis by 6 or 8 spokes; the exterior one is divided on its inner side into 360°, and the interior one carries the verniers.

Perpendicular to the plane of these circles, and in their centre, is a steel axis, around which the two telescopes A A′, B B′, revolve. Figure 59 shows the manner in which these telescopes should be arranged to be free and independent in their movements. This steel axis, or shaft, penetrates the centre of the bore of a cylinder which passes through the piece V, and is soldered to the centre of the *drum* T. When this drum is turned around its axis from X, towards T and Z, the vertical motion being stopped by the clamp screw P, it carries with it the limb and the two telescopes, without moving them from the plane of the two objects. The periphery of the *drum* is cut into notches, into which an endless screw works, and communicates slight motions to the limb in its plane. This screw is pressed against by a

steel spring, which being removable, the screw can be disengaged, and large movements communicated to the limb by the hand. The shaft of the drum should be exactly concentric with the limb and the arcs of the verniers.

100. To use the repeating circle, first place the limb M M in the plane of the two objects. Then, place the upper telescope on the zero of the graduation; disengage the drum T from the endless screw and revolve the limb until the upper telescope is directed on the object to the right. When the object is seen in the field of the telescope, re-attach the endless screw, and complete the contact of the object and cross hairs by the small movements of the drum. While this is being done, a second observer directs the lower telescope on the object to the left, and brings it in coincidence with the cross hairs. We have thus the first observation. One observer can perform both of these operations by doing them in succession, but with two the labour is abridged.

The 2nd observation of the angle is made by detaching the drum and turning the entire circle without detaching the limb, carrying with it both the telescopes until the lower telescope is directed towards the object to the right; at the same time the 2nd observer detaching the upper telescope, directs it towards the object to the left. When the first observer completes the coincidence of the cross hairs of the telescope with his object, by means of the drum-screw, the second observer completes his by the use of the tangent screw of the telescope. In the same manner the third, fourth, &c. measurement of the angle is made, each operator observing always on the same objects, but alternating with the telescopes. The arc indicated by the final observation is then divided by the number of measurements, and the quotient is the arc required.

101. It is frequently necessary to find the *angular height of a signal*, that is to say, the angle which a visual ray from the observer to the signal makes with the horizon. This angle is the compliment of the angle which the same ray makes with a line from the observer to the zenith.

To measure the zenith distance, give the repeating circle the position represented in figure 58, by turning the drum on its shaft. Care must be taken to place a weight on the drum sufficient to counterbalance the weight of the limb and telescope, so that the centre of gravity may remain in the axis of the column S, which is placed exactly vertical. The last condition is attained by means of the spirit level, and the screws $v\ v'\ v''$, as will be explained hereafter.

Suppose now that the column and limb are exactly vertical, so that when the circle is turned, its plane shall be vertical in all its positions. The circle in figure 62 is supposed to represent the limb of the instru-

ment in one of these positions; the upper telescope is directed towards a signal H, the zenith distance of which is required. This distance is the angle formed by the visual ray C A with the vertical line C D. We suppose that the telescope has first been fixed at A upon the zero of the graduation, and that it has been directed on H by turning the drum in its plane, the column remaining fixed to the lower plate by the screw H, (see fig. 58.)

The instrument being in the position described, the screw H is loosened and the limb is turned with the column 180°. The telescope A′ A will then take the position E′ E, (fig. 62) and the zero point of the graduation the place E. But the line D D′ will still remain vertical as the revolution is made about this line as an axis. Thus the angle to be measured is E C D. Detach the upper telescope and direct it exactly on the signal H, without deranging the position of the limb. It is evident that the arc A D is the one to be measured, and that the arc A E, described by the telescope is double the zenith distance required. This done, by turning the circle again, together with the shaft to the opposite side, the telescope returns to the position E E′ and the observation is repeated as often as desired.

In this operation the lower telescope is no longer of any use, except to test, by means of a spirit level Q (fig. 58) fixed to it, the vertical position of the column, or rather of the diameter D D′, after revolving the circle about it. This is done in the following manner:

102. After placing the limb and the column vertical, and fixing the telescope A B upon zero, turn the instrument about the column until the limb is in the vertical plane of the object: clamp the column by the screw O, and direct the telescope, which remains fixed at zero, upon the object by turning the limb on its horizontal axis by means of the drum screw. When the cross hairs and the object are in exact coincidence, turn the lower telescope, and by using its tangent screw, bring the bubble in the middle of the glass. Loosen the screw H and turn the instrument around the column S 180°, measured on the circle O. In this position of the instrument the object is still in the vertical plane of the limb, but on the opposite side.

The bubble should now be between the marks indicating the middle of the glass; if it is not, bring it to this place by turning the drum-screw, being careful not to touch the telescope or its tangent screw. Then detach the upper telescope and direct it on the signal: the angle passed over will be double the zenith distance. Observe exactly the place occupied on the limb by the upper telescope, which serves as a point of departure for a second observation. The second observation is conducted like the first, and repeated until the bubble remains in the middle of the glass in both positions of the instrument.

Fig. 58.

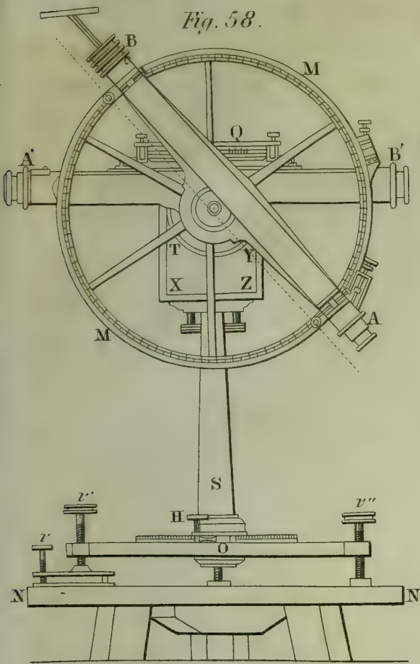


Fig. 59.

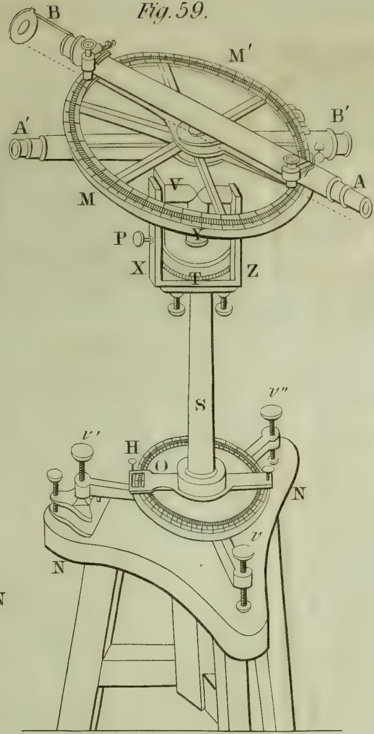


Fig. 70.

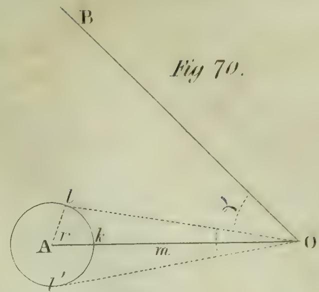


Fig. 76.

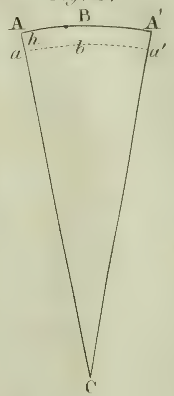


Fig. 77.

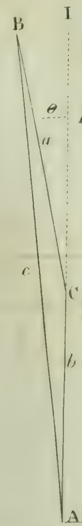


Fig. 61.

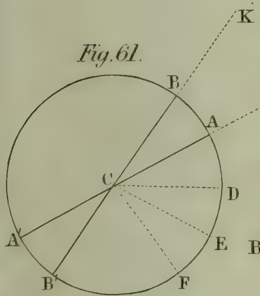


Fig. 62.

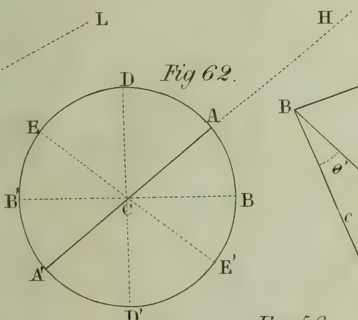


Fig. 63.

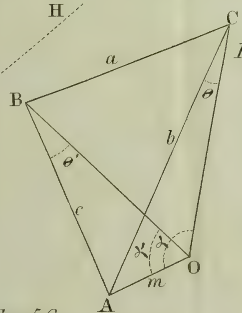


Fig. 65.

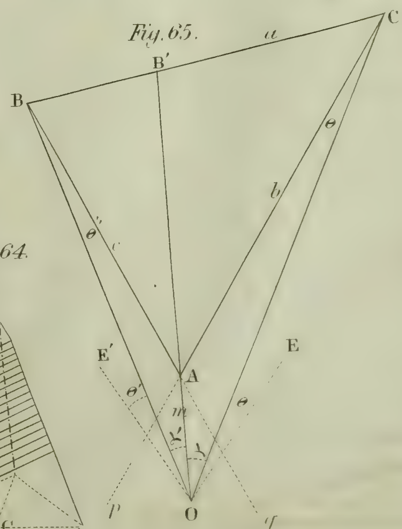


Fig. 67.

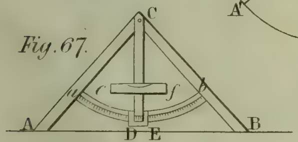


Fig. 56.

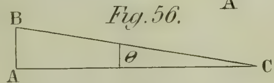


Fig. 57.

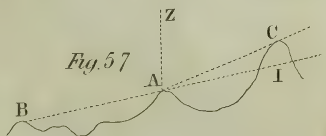


Fig. 64.

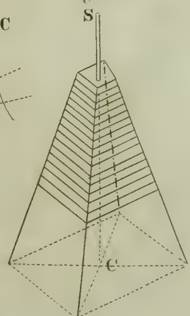
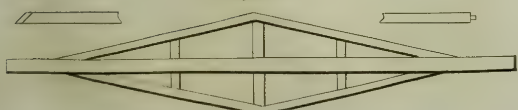


Fig. 68.



The repeating circle is made of brass with steel screws, and in order that the divisions of the limb and the verniers should be very clean and neat, they are made upon a circle of gold or platinum embedded in the brass. For the purpose of reading the graduation with facility, a magnifying glass is placed at each vernier, and the divisions are protected from the reflected light by ground glass.

103. The telescopes are formed of a cylindrical tube with a glass at each end. The *object* glass, or that towards the object, should be convex and achromatic; that is, formed of two glasses joined together; the density of the interior one should be increased by oxide of lead to prevent the image being colored by foreign tints. The object glass should be as large as is convenient to receive as many rays from the object as possible. It unites these rays at a point in the axis of the tube near the other extremity, called the focus, and forms there a well defined image of the object. At this end the eye-glass is placed, near to which the eye is applied. The eye-glass is very convex, and serves to magnify the image which the object-glass makes at the focus. This focus should be common to both glasses, and very near the eye-glass, which is smaller and more convex.

The eye-glass is fitted to a small tube which can be pushed in or out for a short distance, depending upon the vision of the observer, until a clear well defined image of the object is perceived.

The interior of the telescope is furnished with diaphragms opened in the centre, to exclude the scattering rays of light, which destroy the distinctness of the image. Their oblique direction, producing the aberration of sphericity, causes them to be projected at different foci. At the focus of the object-glass is a diaphragm with an aperture, carrying threads of silk or cobweb crossed at right angles. As these threads should be exactly at the focus of the object-glass, and as the position of this focus changes a little, according as the object is nearer or farther removed, the threads should have a motion along the tube. This condition is essential: for if the threads are not exactly at the focus of the object-glass, they will not appear stationary with regard to the image when the eye is moved a little up or down. This is called the *parallax of the threads.* When this defect exists, there is no certainty that the telescope is directed on the object. However, when the object is very far off, a greater or less distance does not sensibly change the focus of the object, and the threads once properly placed do not require to be changed while observing on distant objects.

It is almost useless to say that when the position of the threads is changed, that of the eye-glass must be changed also, so that the image and the threads may both be seen with distinctness. The object-glass remains always stationary. Thus we commence by bringing the cross

hairs to the focus of the object-glass by successive trials, examining each time to see if there is any parallax of the threads, which is done by observing whether the relative positions of the threads and the image appear to change when the eye is moved up and down before the eye-glass. When there is no change there is no parallax, and the tube carrying the eye-glass is moved until the image and the threads are seen distinctly.

These telescopes reverse images, but no inconvenience results from it. Their optical axis should be exactly parallel to the limb.

104. The *spirit-level* is formed of a glass tube containing alcohol, hermetically sealed at the ends. The tube is not quite filled with the liquid, and the space left is called the bubble. Alcohol is used because it does not freeze and break the glass. Care must be taken to give the interior of one of the sides of the tube a circular form; without which the slightest motion will make the bubble pass from one end of the tube to the other without being able to make it rest in the middle. This is done by the friction of sand and emery. For protection, the glass is encased in a brass tube opened on the upper side. Equal divisions traced on the glass and numbered, serve as marks to show if the bubble is in the middle of the tube, for the length of this bubble diminishes by heat which expands the fluid, and contracts by cold, in a greater proportion than the glass. The maker adjusts the tube in its box, so that the bubble will be in the middle when the axis of the tube, or the part of the instrument to which it is attached, is horizontal.

These spirit-levels properly adjusted and placed, serve to test the perpendicular position of the column of the repeating circle, the horizontal position of the plate, and the vertical position of the limb. The manner of adjusting and using them will readily occur to the reader. The art of constructing the glass tube has been brought to such perfection that the inclination of the plane can be calculated, corresponding to the motion of the bubble along the tube of 1. 2. 3. . . millimetres [0.03937, &c. inches], so that it becomes in fact a *slope level*, by which the inclinations of planes can be determined in seconds.

[TO BE CONTINUED.]

Notes on Belgium. By CAPTAIN G. W. HUGHES, *United States Topographical Engineer. Addressed to* FRANCIS MARKOE, JR., ESQ., *Corresponding Secretary of the National Institution, Washington, D. C.*

CONTINUED FROM PAGE 83.

After having seen every thing worthy of attention at Seraigne we left in the diligence for Namur. The valley of the Meuse has been

often compared, but the English think without reason, to the picturesque scenery of the Wye. To me it seemed even more lovely than that beautiful region. The valley of the Meuse is narrow but cultivated like a garden to the hill tops. When the slopes are too steep to retain the soil they are divided by stone walls into several terraces, and where the exposure is favorable the vine is grown. It does not, however, produce good wine, the best of it not being much superior to the *vin ordinaire.*

"Stern visaged war" has indelibly impressed his rugged features on this lovely vale. The villages, chateaus, churches, roads, walls and bridges, all seem to have been constructed for purposes of defence—every house is a fortress and every yard is an advanced work. Each beetling cliff is crowned, and the whole country appears clad in complete panoply of war. At Huy (pronounced *we*) the road crosses to the right bank of the river over an ancient stone bridge, and passes directly under the walls of an old cathedral, and the citadel which commands the Meuse above and below. It was repaired and enlarged by the English in 1816, and is regarded as one of the strongest works in this land of fortresses. The rock on which it stands is literally covered with the vine. Near Huy, the old sandstone first makes its appearance, overlaying the transition limestone, (which abounds with caverns.) From Huy to Namur the valley becomes very narrow, and the naked and jutting rocks present an imperfectly columnar appearance, having been much disturbed, and at a distance, somewhat resemble the palisades of the North River.

Feb. 17th. Went to-day to examine the celebrated Citadel of Namur, situated on a narrow rock at the confluence of the Sambre with the Meuse. This is a most wonderful work, and has been called the Gibraltar of Belgium. Wall after wall, rampart after rampart, fort after fort, surrounded with wide and deep moats (scarped and counter-scarped, and broken up with traverses,) and all connected with covert ways, bomb proof and loop-holed, and subterranean galleries, rise from the level of the rivers to the height of nearly 600 feet, on which stands the citadel, with its faces, flanks and curtains completely casemated. Its trace is irregular, but conformable to the contour of the ground, or rather rock, on which it is built, and with which it is incorporated. On the very highest part of the bridge is an advanced work, designed by the Duke of Wellington, and executed at the expense of the British government. This advanced work is built on a deposite of iron ore and imperfect coal, which is not permitted to be worked.

It strikes me that this fortress, like every other similar work in this part of the world, is placed *too high* for its principal design, which was the defence of the valleys of the Sambre and Meuse; but as it regards

its own defence, I should think it as nearly impregnable as human skill can render any naturally strong military position, and that it could not be reduced except by a long continued blockade. Its casemates are seven feet thick at the crown of the arches, and it is surrounded by galleries and mines, while an abundant supply of water for a numerous garrison, rises within its walls. The bridges across the river are both fortified, and the city is a walled town.

It must not be forgotten by the traveler, that here "Uncle Toby" distinguished himself at the Forte St. Nicholos, and it was here "our army swore so terribly," an accomplishment which seems to have been legitimately handed down in the military line to the present day.

Namur is celebrated for its cutlery, and has been called the Sheffield of Belgium. I visited one of the largest cutlery establishments in this city, and was highly gratified with what I saw. I remained long enough to see every process from the forging of the knives to the finishing and packing them. The *tempering* of pen knives, scissors and razors is accomplished by heating them to a certain degree, obvious only to an experienced person, and then dipping them in cold water. Lancets are tempered in cold tallow, and table knives in oil. This imparts more elasticity to the metal than it receives from the other processes.

Belgium abounds with coal and iron mines, marble quarries and building materials of various kinds, and the working of these minerals occupies a high rank among the great interests of the kingdom.

The mining territory of Belgium may be regarded as divided into three districts. The first includes Hainaut and consists of 155 mines, underlaying 256,000 English acres. The second is situate in the Provinces of Namur and Luxembourg, and contains 59 mines, underlying 75,000 acres, and the third embraces the Provinces of Liége and Limbourg, has 138 mines, under 80,000 acres: making in all 352 mines, underlying 411,787 acres, or 66 square leagues of 5,000 metres.

Of the mineral riches, coal (houille*) is regarded as the most important, the more especially as the country, excepting the mountainous districts of Ardennes, is almost destitute of any other species of combustible, and it not only supplies nearly the whole of Belgium with fuel, but a large quantity is annually exported to France from the Southern Provinces, Hainaut alone producing more coal (charbon de terre) than the whole of France.† The four central collieries of Mons, Morimont and Liége yield annually 3,200,000 tons (of 1,000 Kilo-

* This term is, I think Walloon. The Walloon dialect is very similar to the ancient, and now very nearly obsolete, French language.

† In France 198 mines are worked, employing 17,500 miners, and yielding 60,000,000 of bushels of coal, or about 2,000,000 of tons (of 1,000 Killogrammes) valued at $3,600,000.

grammes—the kilogrammes being equal to 2.20548 lbs. avoir du-pois). In 1836, 456 pits were worked for coal in 250 mines, and gave employment for 31,196 workmen, producing 96,000,000 of English bushels, valued at more than $6,000,000. The price per ton at the pit's mouth was in 1837 at Charleroi from $3.75 to $3.50, and at Mons, from $2.50 to $2.75, and the prices at present are very nearly the same on an average. The cost of mining a ton of coal at Liege, is but little less than $2.00. The State owns a colliery called Kerkroade, in Limburg, the rents of which per annum amount to about $50,000.

In Flanders, Luxemburg, and some other localities, turf is used for fuel, and at Antwerp, Bruges and Ostend, English coals are consumed, as they are imported free of duty.

The following analyses of Belgian coals have been kindly furnished me by the Director in Chief of Mines, Mr. Canchy. A mean of several of the best coals gives the following results, viz:

	Spec. gr.	carbon.	hydrogen.	oxygen.	azote.	cinders.	Remarks.
1st.	1.276	84.67	5.29	7.00	0.94	2.10	These are called *fat* coals, 'le houille grasse á longue flamme.'
2nd.	1.292	83.87	5.44	7.00	0.03	3.68	

He says that no Belgian coals are employed in their natural state for the reduction of iron ores.

I am indebted to Major Frederickx, of the Royal Foundry, for the following analyses of five specimens of coal from the left bank of the Meuse, in the Province of Liege, by C. Davreux.

Major Frederickx observes that the specimens Nos. 1 and 2 are the best combustibles of Liege, and possess great calorific powers, and are generally employed in the reverberatory furnaces. Nos. 3, 4 and 5 are inferior in quality, and are used for ordinary smith's work, and for generating steam.

Specimens,	1	2	3	4	5
Carbon,	0.783	0.760	0.699	0.726	0.685
Ashes,	0.039	0.044	0.067	0.032	0.103
Volatile matters,	0.178	0.196	0.234	0.242	0.212
	1.000	1.000	1.000	1.000	1.000

1 and 2 coal from the mine of Marair of Ste. Marguerite.
3 " 4 " " " " *Olisson* au val Benoit.
5 " " " " Cerisier a la Haye a St. Gilles.

Analysis of Mineral Coals from the district of Mons, by Berthier.

FAT COALS.

	1	2	3	4
Carbon,	0.715	0.653	0.585	0.510
Ashes,	0.052	0.017	0.030	0.050
Volatile matter,	0.233	0.830	0.385	0 040
		1.000	1.000	1.000
* Lead with litharge,	1.000	29.0	28.1	27.4
Carbon equivalent to the volatile matter.		0.22	0.24	0.30

* "Plomb avec la litharge."

No. 1. Coal from the Canton of Dour. Fragile, of a homogeneous blackish colour without being earthy. Its density is 1.27, and it yields from 0.65 to 0.68 per cent. of excellent coke.

No. 2. From the *Vein of Bouleau—Fontaine-Madame*, near Mons. Its density is from 1.260 to 1.287; it yields 0.55 per cent. of "beautiful coke."

No. 3. From the Bed of Grand-Gaillet.

No. 4. From the Gade Vein. The coke of this coal swells very much, (tres boursoufflé) and is light and porous. The coal is admirably adapted to the generation of gas.

Composition of the dry, or anthracite coals of Mons.

Carbon, - - - -	0.850
Ashes, - - - - -	0.023
Volatile matter, - - -	0.127
	1.000

Mr. Dumont says, "the combustibles employed for the reduction of metallic ores, are coke and charcoal. In Ardennes they use carbonized wood, (le bois torrifié.)

No copper is reduced in Belgium, but a great deal of brass or yellow copper ("cuivre jaune") is manufactured, and also of bronze; but it is difficult to ascertain the precise amount of the annual production.

The following coals from Liege are by M. Delvaux of the School of Mines:

No. 1. A slaty coal, easily broken and of splintery fracture. It is from the colliery of "l'Arbre St. Michel," commune of *Harion*, Hozemont, and was taken from the "Dure veine," or hard vein. Its coke is greyish and brilliant; its density 1.365, yields 91.0 of coke; its calo-

rific power 7861.4; the equivalent of carbon to volatile matter 0.18629.

Composition.

Carbon.	Ashes.	Volatile matter.
81.9	9.10	9.00 = 10.000

No. 2. Fragile, schistose, lustre resinous, from the colliery of Baldaz-la-lore, commune of *Chokier,* and bed *Petite Hareng.* Density 1.286; coke very much swelled, (tres boursoufflé), of which it yields 83.67.

Composition.

Carbon.	Ashes.	Volatile matter.
71.68	11.96	16.36 = 100.00.

No. 3. Schistose, lustre resinous, from the colliery of *Bonnier,* bed *Moset.* Its density 1.318. Coke pulverulent, of which it yields 92.00.

Composition.

Carbon.	Ashes.	Volatile matter.
91.388	0.612	8.00 = 100.00.

I have been at some trouble to obtain these results, in the hope that they may be rendered useful, as a means of comparison between our ores at home and those of foreign mineral productions.

Iron mines are very common in this country. The ores closely resemble in organic composition, those of France; they contain nearly the same elements, and produce iron of almost the like quality, but the French iron brings generally the highest price in market, which may be owing, in a great degree, to its being reduced with charcoal.

There is perhaps no country in Europe of the same extent, that contains more iron ores and a greater variety of them, than that between the Sambre and the Meuse. It is this district which furnishes the minerals for the furnaces of the Sambre, and partly for those of the Meuse and Liege. Besides this district there are a great number of mines worked in the Provinces of Liege, Limburg and Luxemburg. In 1836, the blast furnaces consumed 456,000 tons of worked iron ore, being about one half of the unworked ore as it is extracted from the earth. The ore is worked to free it from the earthy matter, which adheres to it. The consumption has greatly increased since 1836, but I have seen no authentic returns of the present amount.

I am indebted to the superintendent of the Royal Foundry for the following analysis of iron ores employed at the foundry. He says, "I regret not having been able to obtain analyses of all the iron ores employed in the reduction of the iron used for the fabrication of cannon at the Royal Foundry; but I send you the results of four specimens of

the best ores, which produce a very strong iron. The other ores do not differ materially in composition from them."

Analysis of four specimens of hydrated oxide of Iron from Hotbomont, near de Theux, Liége, by C. Davreux.

Specimens,	1	2	3	4
Peroxide of iron,	0.839	0.804	0.732	0.591
" " manganese,	0.023	0.036	0.099	0.115
Silex,	0.031	0.039	0.035	0.103
Alumine,	0.000	0.008	0.012	0.050
Lime,	0.000	a trace	0.003	0.007
Water,	0.107	0.113	0.119	0.134
	1.000	1.000	1.000	1.000

Mr. Cauchy, the Chief Director of Mines, says that there are two very distinct species, or classes, of iron ores. The one a *red oxide*, extremely rich, but yielding a brittle iron, owing to the presence of phosphoric acid—the other a yellow and brown hydrated ore, yielding not more than 30 or 40 per cent. of metal, in consequence of its being very argillaceous, but the iron is of an excellent character and very strong.

I am indebted to Professor Dumont, of Liege, (at the instance of M. Juetelet, perpetual Secretary of the Royal Academy of Brussels,) for the following analysis of iron ores.

Analysis of the Limonite, (Hydrated Oxide of Iron,) from the Angleur Mine, near Seraigne. By Professor Le Soinree.

This limonite is zinciferous.

10 grammes* of crude ore = calcined ore,		8.30
We add for a flux,	Argile,	1.00
	0.8 carbonate of lime = quick lime,	0.45
	Total of fixed matter,	9.75
We obtained	of pig iron, 4.52,	
	of scoria, 1.63, =	6.15
	Loss in oxygen and oxide of zinc,	3.60

The solvent, or flux, (le fondant,) was 1.45. There remain for the vitreous matter of the ore, 0.18, and the zinc was entirely volatilized. The iron was gray, and of a good quality.

* The gramme is = 18.8 grains, or the one thousandth of a kilogramme.

Analysis of the same Ore. By Mons. Berthier.*

Oxide of iron, - - -	0.626
Water and carbonic acid, -	0.170
Silex, - - - -	0.032
Oxide of zinc, - -	0.172
	1.000

Analysis of the Argillaceous Carbonate of Iron of the Coal Measures (fer Carbonatè Argileux de Houilleries,) of Dour, (Mons.) By Berthier.

10 grammes of crude ore = of calcined ore,			7.60
Added as flux, 3.60 of lime stone = of quick lime,			2.03
Total,			9.63
And we obtained	of pig iron, 2.37,		
	of scoria, 6.20, =		8.57
Loss in volatile matter,			1.06
Flux, - - - - -		2.03	
Vitreous matter of the ore, - -		4.17	
Insoluble, " - - - -		3.60	
Soluble, " - - -		0.57	

The metal was grayish, and good for rolled iron. The slag was vitreous, transparent, and of a deep gray colour.

Analysis of the Limonite of Bayon, (Liege,) made at the Laboratory of the School of Mines. By M. Delvaux.

This mineral is of a dark brown colour, hard, and compact. It loses, by calcination, 0.19 of water and carbonic acid, and when treated with hydro-chloric acid, leaves a residuum of silex = 0.032. Weak nitric acid dissolves 0.181 of carbonate of lime, and 0.024 of carbonate of zinc.

10 grammes of crude ore = of calcined ore,		8.10
There was added, as a flux,	Silex,	1.55
	Clay,	1.00
Lime stone, 2.50 = of lime,		1.41
Total of fixed matter,		12.06

* It was from this ore the best gun metal was formerly obtained for the Royal Cannon Foundry; but it is all used, at present, at Seraigne.

Amount forward,				12.06
There was obtained,	metal,	3.65 (of iron,)		
	slag,	5.32	=	8.97
	Loss,			3.09

The flux added,	3.96
Insoluble matter,	0.32
Soluble "	1.04

There remained, of the vitreous matter of the ore, 1.36.

The metal obtained was gray, and malleable.

Analysis of a Specimen of Pig Iron, (fonte,) from Charleroi. By Berthier.

This iron was prepared with coke, is of a *deep*, or *dark* gray colour, without being black; is very soft, and makes the best castings for machinery of any iron of the continent.

Carbon, - - - -	0.023
Silex, - - - -	0.035
Iron, - - - -	0.942
	1.000

Ores of Zinc. By Berthier.

Anhydrous carbonate of zinc, from Ampsin, near Huy.

Oxide of zinc,	0.574	0.890 carbonate of zinc,
" iron,	0.040	0.065 " " iron,
" manganese,	a trace	0.042 gangue,
Water and carb. acid,	0.341	
Earthy gangue,	0.042	0.997
Total,	0.997	

Calamine from "Old Mountain," between Liege and Aix la Chapelle.

	No. 1.	No. 2.
Oxide of zinc,	0.632	0.054
Silex, - -	0.256	0.020
Water, - -	0.010	0.006
Carbonate of zinc,		0.890
Oxide of iron, -	0.048	0.030
Alumina, -	0.034	
	0.980	1.000

No. 1. Anhydrous calamine.

No. 2. The ordinary yellow amorphous ore of zinc. It is a mixture of the anhydrous carbonates, and the hydrated silicates of zinc. This mineral, when calcined and decomposed, is found to consist of the following constituents.

Oxide of iron, - - - -	0.083
" zinc, - - -	0.647
Carbonic acid and water, - -	0.072
Alumina and silex, - - -	0.195
	0.997

The extraordinary abundance of the mineral resources of Belgium, including fuel, has given rise to the establishment of numerous works for the manufactory of castings, of rolled iron, of steel, of sheet iron, of copper, and of tin. This branch of industry may be considered as divided into three principal groups. *First*, the River group, (that of the Meuse, from its entrance into Belgium to the limits of the Provinces of Namur and Liege.) *Second*, the group between the Sambre and Meuse, (including the furnace of Couvin,) and *third*, the group of Charleroi, (to which are attached the furnaces of Clobecq, near Tubin.) Beside these groups, we must observe that on the Floyoux, on the Ourthe, and on the tributaries to this latter river, there are a large number of blast furnaces, forges, rolling mills, and foundries. In 1837, there were in Belgium, twenty-three blast furnaces, worked with coke, and sixty-six with charcoal, in constant use.* There are at present not less than forty-five coke furnaces in operation, and the number is rapidly increasing. A company has recently erected, on the plains of Sclessin, six enormous coke furnaces, in a single stack, of dimensions heretofore unknown on the continent.

It is estimated that the furnaces of this kingdom produce nearly 200,000 tons (of 1000 kilogrammes,) of iron, annually; the French furnaces yielding about 300,000 tons, and the English considerably more than 600,000.

From 1830 to 1836, the mean price of rolled iron was, for the best quality, about $80 per ton, and for the second quality, $60 per ton, the highest price having been paid for the first quality, $90, and the lowest, $75. There is, at present, quite a depression in this branch of production.

Copper ore is found principally in the provinces of Hainaut and

* In France, there are 508 blast furnaces, of which twenty-eight only are worked with coke. It has been ascertained that coke furnaces yield from three to five times more metal than the charcoal furnaces.

Liege; lead in those of Liege, Namur, and Luxemburg, in which is situated the Longilly mine, the most important locality in the country. Zinc is worked at Namur and Hainaut; manganese in Liege; pyrites, calamine, sulphur, and alum, in Namur and Liege.

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the cost of Embankments of Earth, when made with Carts.

By Ellwood Morris, *Civil Engineer.*

Early in his professional career, the writer had frequent occasion to deplore the want of accurate knowledge, regarding *the cost per cubic yard* of embankments of earth; having sought through books *in vain* for correct information upon this point, he endeavoured to supply the defect by application to the experience of elder practitioners, but soon found that even the most experienced Engineers, whom he had the opportunity of consulting, possessed only vague and uncertain information upon this subject; they decided the value of embankment by judgment alone—hence they were frequently mistaken—and none with whom he then conferred, seemed to be acquainted with any rule for the general determination of this question from easily acquired data; this apparent deficiency amongst professional men, concerning a matter of such importance as the value of embankment, entering so largely as it does into the construction of public works, attracted the fixed attention of the writer, and determined him to commence, and upon every convenient occasion to prosecute, a series of experiments with different soils and lengths of hauling, until sufficient data was acquired to enable him to effect a practical solution of *the problem of the value per cubic yard of embankments of earth of any given average haul.*

The observations necessary for the acquisition of suitable data, were made in the formation of embankments of different soils, in different situations, in various stages of weather, and with mean lengths of haul ranging from 100 to 1800 feet; these preliminaries were completed some years ago, formulæ based upon these were drawn out, and now after having satisfactorily tested their accuracy by actual application, to the ascertained cost of embankments of different soils and average hauling, amounting in the aggregate to *more than one hundred and fifty thousand cubic yards;* the writer conceives that they have been verified by practice, upon a scale sufficiently large to warrant him in offering them to the public, with the assurance that *these formulæ may safely be relied upon in practice.*

Owing to the great diversity observable in the consistency of the natural soils, whence embankments are usually formed, something

must of course be left to the judgment of the Engineer; but it is fortunately practicable, both to rescue from the dominion of conjecture, the chief items of cost, and also to confine the chances of errors within very narrow limits—such is the inherent character of the question solved by our formulæ—how successfully, will appear in the comparisons we shall hereafter adduce, between the carefully ascertained cost of several considerable embankments, and the value per cubic yard, which under the same circumstances, would result by computation from the formulæ.

Vehicle and pace of Transportation.

Unlike the course usually pursued *abroad*, where embankments are generally made by cars, carried out upon a temporary railway, and dumped in a single breast of the full height of the bank; *in this country* embankments are almost invariably *formed in layers, and the materials hauled on in carts drawn by a single horse.*

A one horse cart is assumed to be the vehicle of transportation to the embankments of which our formulæ will determine the cost, and it is *to carted embankments alone* that the present remarks and computations are designed to apply.

A numerous series of experiments repeatedly verified, indicate that the average pace of a horse in carting embankment, is at the rate of *one hundred feet of trip or* 200 *feet lineal per minute;* by *trip* we design to include *both* going out and coming back, the outward pace with the load being a little slower, and the inward rather faster, so as to establish as *a mean result* the progress stated above.

Classes of Earth, and days' work of Men loading each.

For practical uses it will be sufficient to divide common earth into *three classes,* varying in their consistency and somewhat in their density, though such a classification must necessarily be arbitrary, as it is utterly impossible so to classify earthy materials, as to meet and cover *exactly* every practicable case.

1st class.—*Gravelly Earth.*—This includes all such materials as gravel, or gravel and clay mixed, and in fact all the heaviest and firmest earths.

Satisfactory experiments have established the fact, that of the material we call *gravelly earth,* a medium laborer will load into a cart in ten working hours, *ten cubic yards measured in bank.*

2nd class.—*Loam.*—This includes those earths so generally found, which consist mainly of sand and clay mixed.

Of this material, experiments indicate, that a medium laborer will, within ten hours work, load into a cart, *twelve cubic yards measured in bank.*

3rd class.—*Sandy Earth.*—This includes the marly earths, along with those in which sand predominates; this material is usually light, loose, and easily handled.

Experiments have proved, that of this species of material a medium laborer in ten hours of work, will load into a cart, *fourteen cubic yards measured in bank.*

To load, of the several classes of earth respectively, material equivalent to 10, 12, and 14 cubic yards *measured in bank,* requires the lifting of about $\frac{1}{9}$ more if *measured in excavation,* and this is owing to the well known *compression of earth when placed in bank,* a subject we do not propose to discuss in this connexion, as it does not seem indispensably necessary to the present purpose.

Species of haul, and cartload in each.

As we have made a practical division of earthy materials, into three species, so also will we classify the hauling in its application, to average weather, and such embankment roads as are commonly used upon well managed works, and in deciding to which class any particular case of hauling belongs, *the general features of the road and the probable draft thereon,* must be carefully considered, as no exact and universal rule can be established.

1. *Descending hauling.*—In this species carts usually carry $\frac{1}{3}$ of a cubic yard *measured in bank.*

2. *Level hauling*—In this species carts generally average $\frac{10}{35}$ of a cubic yard *measured in bank.*

3. *Ascending hauling*—In this species carts generally carry $\frac{1}{4}$ of a cubic yard *measured in bank.*

Loosening the material.

Shovels with short handles are usually employed in loading earth for embankments, but before the shovellers can operate, it is generally necessary to *loosen the material* either by *the pick or plough,* though the lighter soils of the third class (*sandy earth*) may frequently be spaded at once into carts.

Gravelly earth, and the stiffer kinds of clay generally require to be loosened by *the pick. Loam* can almost always be *ploughed* by a good team, and *sandy earth,* when it cannot be *spaded,* will always yield to *the plough.*

The expense of *loosening* or preparing the earth to be loaded into carts by the shovellers, will seldom be less than *one,* and not often more than *eight cents* per cubic yard, but this is one of those subordinate items which is variable in its nature, and must necessarily be left to be fixed by the judgment of the Engineer, upon view of the

material, the cost of forming which into an embankment of *a given mean haul*, he desires to know.

In *loam* the writer found, by a number of experiments, that a three horse plough would loosen for the shovellers, from 250 to 800 cubic yards per day, which, when the plough and drivers cost $5 per day, would cause the value of *loosening* to vary from two cents to six mills per yard; hence it is evident that an error in estimating the value of loosening, will not very essentially affect the results produced by our formulæ, because this item is but *a small part of the whole cost* of a cubic yard of bank.

Notation and Data.

Constant quantities ascertained by carefully verified experiments.

1. Number of feet of *trip* traveled by each cart per minute = 100 feet, or 200 feet lineal actually moved over.

2. Number of cubic yards of earth *measured in bank* which can be loaded per day of ten hours working time, by a medium laborer, viz:

Of *gravelly earth*		= 10	cubic	yards.
Of *loam*	"	= 12	"	"
Of *sandy*	"	= 14	"	"

3. *Time lost* in loading, dumping, waiting to load, and all other lost time, per load = 4 minutes.

4. Number of cart loads to the cubic yard of bank.

In *descending hauling*	= 3
In *level hauling*	= $3\frac{1}{2}$
In *ascending hauling*	= 4

5. Cost of trimming and bossing, at a general mean ascertained to be about *one cent* per cubic yard.

Variable quantities, some of which depend upon the prices of labor, and others upon a correct judgment of the circumstances of the case.

a = *average haul* of the embankment, in stations of 100 feet each; thus calling 1245 feet 12 $\frac{45}{100}$ stations.

b = *number of hours actually wrought* per day, which will average through the year about ten hours working time per day.

c = *daily wages of one laborer*, including all allowances, in cents.

d = *daily wages of one cart,* including driver and all other expenses, in cents.

e = *cost of loosening the material* in cents per cubic yard.

The above or the variable quantities, can generally be determined in every case with sufficient accuracy.

Unknown quantities, which will be determined by the solution of the several formulæ.

x = number of cubic yards measured in bank, which can be hauled *by each cart per day*, to the distance of the given average haul, and there deposited.

y = the cost in cents of *one cubic yard of embankment* of the given average haul; clear of all profit to the contractor or person doing the work.

Formulæ, for finding x, the load in cubic yards hauled per day by each cart.

Representing the number of cartloads to the yard by f, the general formulæ will be,

$$\frac{\left(\frac{60}{\frac{a}{100}+4}\right)b}{f} = x.$$

Now substituting successively in the general formulæ instead of f, its numeral values in the several species of hauling (3, $3\frac{1}{2}$, 4,) and then operating upon the resulting formulæ, according to the laws which govern the mutations of algebraic fractions, we derive the following equations:

For *Descending hauling*, $$\frac{20\ b}{a+4} = x. \quad . \quad . \qquad (\text{I.})$$

For *Level hauling*, $$\frac{17\frac{1}{7}\ b}{a+4} = x. \quad . \quad . \qquad (\text{II.})$$

For *Ascending hauling*, $$\frac{15\ b}{a+4} = x. \quad . \quad . \qquad (\text{III.})$$

Formulæ for finding y, the net cost per cubic yard of embankment of earth.

Denoting the number of cubic yards of each class of earth, which can be loaded by a medium laborer in a day of ten hours working time, as heretofore stated, by the symbol g, and putting one cent, for the cost of trimming and bossing per cubic yard; the general formula will be,

$$\frac{c}{g}+\frac{d}{x}+e+1=y.$$

On substituting successively for g its numeral values (10, 12, 14,) in the several different classes of earth, we have,

1st class—*Gravelly earth*, $$\frac{c}{10}+\frac{d}{x}+e+1=y, \quad . \qquad (\text{IV.})$$

2nd class—*Loam*, $$\frac{c}{12}+\frac{d}{x}+e+1=y, \quad . \qquad (\text{V.})$$

3rd class—*Sandy earth*, $$\frac{c}{14}+\frac{d}{x}+e+1=y, \quad . \qquad (\text{VI.})$$

Formulæ, for finding the cost per cubic yard of Embankments of Earth, verified by practice.

The chief part of the cases we are about to cite, as proving the accuracy of our equations of cost, in all which the actual expense of some considerable embankments became known to the writer in a mode that precluded the possibility of mistake, is derived from actual practice upon the Chesapeake and Ohio Canal.

EXAMPLE 1.

Amount of embankment = 28,100 cubic yards.
Material of earth of the second class, *loam.*
Level hauling, an average of $6\frac{1}{2}$ stations, or 650 feet, . = a
Loosening by the plough alone, $1\frac{2}{3}$ cents per cubic yard, . . = e
Hours wrought per day = 10 . . . . . . = b
Laborers' wages per day at an average of 106 cents, . . = c
Carts' wages " " " 157 cents, . . = d
Bossing and trimming per cubic yard = 1 cent.

Actual cost of the 28,100 cubic yards of embankment, clear of bossing and trimming = \$5363.

		cents.
Cost per cubic yard = $\frac{\$5363}{28,100}$	=	$19\frac{}{1}$
Add for bossing and trimming, ...	=	1
Total cost per cubic yard, ...	=	$20\frac{}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\frac{17\frac{1}{7}\ b}{a+4} = x$ substituting for a and b their numeral values,

we have $\frac{17\frac{1}{7} \times 10}{6\frac{1}{2}+4} = \frac{\frac{1,200}{7}}{10.5} = \frac{1,200}{73.5} = 16\frac{3}{10}$ cubic yards $= x$.

2nd. By Formula (V.) to find y, the cost per cubic yard in bank.

(V.) $\frac{c}{12} + \frac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have $\frac{106}{12} + \frac{157}{16.3} + 1.67 + 1 = 21\frac{1}{10}$ cents $= y$, the cost per yard.

Difference between the real and calculated cost = 1 cent per yard.

EXAMPLE 2.

Amount of Embankment = 42,140 cubic yards.
Material of Earth of the third class; *sandy earth.*

Level hauling, an average of 9 stations, or 900 feet, ... $= a$
Loosening by plough and spade $= 1$ cent per cubic yard, . . $= e$
Hours wrought per day $= 10$, ... $= b$
Laborers' wages per day at an average $= 110$ cents, . $= c$
Carts' wages " " " $= 160$ cents, . . $= d$
Bossing and trimming $= 1$ cent per cubic yard.

Actual cost of the 42,140 cubic yards clear of bossing and trimming $= \$8,775$.

		cents.
Cost per cubic yard, $= \dfrac{\$8,775}{42,140}$	. . . . . .	$= 20\frac{8}{10}$
Add trimming and bossing,	. . . . . .	$= 1$
Total cost per cubic yard,	. . . . . .	$= 21\frac{8}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\dfrac{17\frac{1}{7}\, b}{a + 4} = x$. Substituting for a and b their numeral values,

we have, $\dfrac{17\frac{1}{7} \times 10}{9 + 4} = \dfrac{\frac{1,200}{7}}{13} = \dfrac{1,200}{91} = 13\frac{2}{10}$ cubic yards $= x$.

2nd. By Formula (VI.) to find y, the cost per cubic yard in bank.

(VI.) $\dfrac{c}{14} + \dfrac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have, $\dfrac{110}{14} + \dfrac{160}{13\frac{2}{10}} + 1 + 1 = 22$ cents $= y$, the cost per yard.

Difference between the real and calculated cost $= \frac{2}{10}$ of a cent per cubic yard.

Example 3.

Amount of Embankment $= 23,500$ cubic yards.
Material of Earth of the third class; *sandy earth.*
Ascending hauling, an average of 6 stations, or 600 feet, . $= a$
Loosening by the plough and spade $= 1$ cent per cubic yard, $= e$
Hours wrought per day $= 10$, ... $= b$
Laborers' wages per day at an average $= 120$ cents, . . $= c$
Carts' wages " " " $= 165$ cents, . . $= d$
Bossing and trimming $= 1$ cent per cubic yard.

Actual cost of the 23,500 cubic yards of embankment clear of bossing and trimming $= \$4,939$.

Cost per cubic yard $= \dfrac{\$4,939}{23,500}$		cents. $= 21$
Add for bossing and trimming, ...		$= 1$
Total cost per cubic yard, ...		$= 22$

Cost by the Formulæ.

1st. By Formula (III.) to find x, the load hauled per day.

(III.) $\dfrac{15\ b}{a + 4} = x$. Substituting for a and b their numeral values,

we have, $\dfrac{15 \times 10}{6 + 4} = \dfrac{150}{10} = 15$ cubic yards $= x$.

2nd. By Formula (VI.) to find y, the cost per cubic yard in bank.

(VI.) $\dfrac{c}{14} + \dfrac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have, $\dfrac{120}{14} + \dfrac{165}{15} + 1 + 1 = 21\frac{6}{10}$ cents $= y$, the cost per cubic yard.

Difference between the real and calculated cost $\frac{4}{10}$ of a cent per cubic yard.

EXAMPLE 4.

Amount of Embankment = 36,000 cubic yards.
Material of Earth of third class; *sandy earth.*
Level hauling, an average of $9\frac{2}{10}$ stations, or 920 feet, . . $= a$
Loosening by plough and spade = 1 cent per cubic yard, . $= e$
Hours wrought per day = 10, ... $= b$
Laborers' wages per day at an average = 118 cents, . $= c$
Carts' wages " " " = $162\frac{1}{2}$ cents, . . $= d$
Bossing and trimming = 1 cent per cubic yard.

Actual cost of the 36,000 cubic yards of bank, including bossing, &c., = \$8,149.

Cost per cubic yard, $= \dfrac{\$8,149}{36,000}$		cents. $= 22\frac{6}{10}$
Bossing, &c., ...		0
Total cost per cubic yard, ...		$= 22\frac{6}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\dfrac{17\frac{1}{7}\ b}{a + 4} = x$. Substituting for a and b their numeral values,

we have, $\dfrac{17\frac{1}{7} \times 10}{9\frac{2}{10} + 4} = \dfrac{\frac{1,200}{7}}{13\frac{2}{10}} + \dfrac{1,200}{92\frac{4}{10}} = 13$ cubic yards $= x$.

2nd. By Formula (VI.) to find y, the cost per cubic yard in bank.

(VI.) $\dfrac{c}{14} + \dfrac{d}{x} + e + 1 = y$. Substituting the numeral values for the letters,

we have, $\dfrac{118}{14} + \dfrac{162\frac{1}{2}}{13} + 1 + 1 = 22\frac{6}{10}$ cents $= y$, the cost per cubic yard.

Difference between the real and calculated cost $\frac{3}{10}$ of a cent per cubic yard.

EXAMPLE 5.

Amount of Embankment = 22,075 cubic yards.
Material of Earth of the second class; *loam.*
Level hauling an average of 10 stations or, 1000 feet, . . = a
Loosening by heavy ploughs = $2\frac{1}{2}$ cents per cubic yard . . = e
Hours wrought per day = 10. . . . . = b
Laborers' wages per day at an average = 125 cents, . . = c
Carts' wages " " " = 175 cents, . . . = d
Bossing and trimming = 1 cent per cubic yard.

Actual cost of the 22,075 cubic yards of embankment, including bossing, &c., = $6,166.

	cents.
Cost per cubic yard $= \dfrac{\$6,166}{22,075}$	$= 27\frac{9}{10}$
Bossing, &c., ...	$= 0$
Total cost per cubic yard, ...	$27\frac{9}{10}$

Cost by the Formulæ.

1st. By Formula (II.) to find x, the load hauled per day.

(II.) $\dfrac{17\frac{1}{7}\, b}{a + 4} = x$. Substituting for a and b their numeral values

we have, $\dfrac{17\frac{1}{7} \times 10}{10 + 4} = \dfrac{\frac{120}{7} \times 10}{14} = \dfrac{1,200}{98} = 12\frac{3}{10}$ cub. yds. $= x$

2nd. By Formula (V.) to find y, the cost per cubic yard in bank.

(V.) $\dfrac{c}{12} + \dfrac{d}{x} + e + 1 = y$. Substituting the numeral values of the letters,

we have, $\dfrac{125}{12} + \dfrac{175}{12\frac{3}{10}} + 2\frac{1}{2} + 1 = 28\frac{1}{10}$ cents $= y$, the cost per cubic yard.

Difference between the real and calculated cost $= \frac{2}{10}$ of a cent per cubic yard.

Recapitulation of the comparisons between the real and calculated cost per cubic yard of Embankments of Earth containing in the aggregate 151,815 *cubic yards.*

No. of experiments.	Number of cubic yards in the bank.	Average haul in stations of 100 feet each.	Kind of hauling.	Class of the earth.	Actual cost per cubic yard in cents.	Cost calculated by the Formulæ in cents.	Difference per cubic yard in cents.
1	28,100	$6\frac{1}{2}$	level	loam	$20\frac{1}{10}$	$21\frac{1}{10}$	1
2	42,140	9	level	sandy earth	$21\frac{8}{10}$	22	$\frac{2}{10}$
3	23,500	6	ascending	sandy earth	22	$21\frac{6}{10}$	$\frac{4}{10}$
4	36,000	$9\frac{2}{10}$	level	sandy earth	$22\frac{6}{10}$	$22\frac{9}{10}$	$\frac{3}{80}$
5	22,075	10	level	loam	$27\frac{9}{10}$	$28\frac{1}{10}$	$\frac{2}{10}$

An examination of the above table shows that the differences between the *real and calculated cost* per cubic yard, of the several quantities which, when aggregated, form the full amount of 151,815 cubic yards of bank, did in no case exceed *one cent per cubic yard.*

Other tests upon smaller individual amounts having verified the embankment equations with equal precision, the writer hazards nothing in expressing his conviction that the formulæ above given, *will, as general rules, be found trustworthy.*

The formulæ apply equally well to every species of hauling in single carts, by making such slight alterations as would be due to the difference, between the specific gravity of common earth and of the other material proposed to be hauled; thus if the equations are properly transformed, the application of the rules to embankment of rock, hauled in one horse carts is both simple and easy.

Here our remarks naturally terminate, and further the mathematical reader need not progress; but although the foregoing equations of cost, are expressed in the simplest algebraic forms, still as there may be some amongst our readers who are not much used to the symbols of algebra; we will, even at the risk of prolixity and repetition, enunciate them in words at length for the benefit of such persons; the Roman

numerals indicate in the several rules those formulæ which are turned into common language.

To find the load in cubic yards hauled per day by each cart.

I. In Descending Hauling.

Multiply the number of hours wrought per day by the number 20, then divide the product by the number of stations (of 100 feet each) contained in the average haul, added to the constant number 4, and the quotient will be the number of cubic yards which one cart can haul the given distance in a day.

II. In Level Hauling.

Same as rule I, except that the first multiplier must be $17\frac{1}{7}$ instead of 20.

III. In Ascending Hauling.

Same as rule I, except that the first multiplier must be 15 instead of 20.

Having by one of *the rules* above, found the number of cubic yards which a cart can haul in a day of 10 hours' work, upon the kind of road referred to, then by one of *the rules following*, the cost of the embankment per cubic yard may be found, if the class of the earth whence it is formed be known.

To find the cost in cents per cubic yard of Embankment of Earth.

IV. Bank formed of Gravelly Earth.

Divide the daily wages in cents of one laborer by the number 10, add the quotient to that of the daily wages of one cart in cents, divided by the number of cubic yards hauled per day per cart, as found by former rules, and to the sum of these two quotients, add successively the estimated cost in cents per yard, of loosening the material, and one cent for bossing and trimming, the sum of all will be the cost of one cubic yard of the embankment.

V. Bank formed of Loam.

Same as rule IV, except that the first divisor must be 12 instead of 10.

VI. Bank formed of Sandy Earth.

Same as rule IV, except that the first divisor must be 14 instead of 10.

Of course in using any of these rules the average length and kind of haul, the wages, &c., must be previously known as in the several examples adduced.

Philadelphia, July 19th, 1841.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Colonel Long's *Bridges.*

In a former number of this Journal, (see vol. xxiv, pp. 325 to 333,) are exhibited specifications and drawings explanatory of certain improvements in bridge building, under the designations of the brace bridge, and the suspension bridge, patented by Col. Long, on the 7th of November, 1839. In the present number, we take occasion to lay before our readers additional drawings of the same methods of construction, in one of which is presented a side view of an entire truss-frame of the brace bridge, and in the other a similar view of an entire truss-frame of the suspension bridge. (See the drawings on plate II.)

In the figures relating to both methods, the inferior arch braces, with their appropriate gibs, keys, and other fastenings, are represented, rising from their appropriate bearings at the abutment and pier, and connecting with the lower strings, at points suitable for their reception. In the side view of the brace bridge, the appropriate positions of the side arch braces with their sills at the lower, and plates at the upper strings, are represented by dotted lines. On each side of the truss-frame, a sill may be applied at each abutment and pier, in contact with the lower string, and extending through one or more panels, at the discretion of the builder; and in like manner, a plate may be applied midway of each span, in contact with the upper string, and extending through one, or more, panels, from the centre of the span. From the sills, one, or more, arch braces in each half span, may rise and pass diagonally across one, or more, panels, in a direction towards the centre of the span, being extended far enough to reach the plates, with which, as also with the sills, the brace timbers should be connected by means of appropriate notches, tuscums, &c. The side arch braces, sills, and plates, at their junction, should be connected to the truss-frames by screw bolts, and iron plates or washers, the bolts passing entirely through the truss-frame. Screw bolts, in like manner, should be applied at every intersection of the posts by side arch braces. The fastenings at all other points should consist of tree-nails, which should be inserted in such positions, and with such frequency, as to ensure the requisite action and efficiency in those useful parts of the structure.

The arrangement here contemplated, differs very considerably from that provided for, agreeably to the specifications before cited. Its advantages consist in the greater facility and economy with which the inferior and side arch braces may be applied to a truss-frame, and in the greater frequency with which these useful and important parts of the structure may, with convenience, be applied.

S. H. L.

Notices of Railways in Germany.

From the London Railway Magazine.

Although the first railroad in Germany intended for the transportation of passengers and goods, that from Budweis to Lintz, had been undertaken already in 1824, it was not until the last five years that this line of internal communication has been somewhat generally introduced in this part of the European continent. But in this short period a great deal has already been accomplished, and after a few years more, Germany will boast of a railway system by which its principal and important cities will be connected. A description of the different railways already completed, or in course of construction, made from authentic data collected on the spot, will perhaps be of some interest to the readers of the Railway Magazine, not only because England is so much interested in those works, for which it furnishes the iron, machinery, &c., and sometimes even the engineers, but also by making the English traveller acquainted with the means of internal communication of which he can avail himself, on his tours through the continent. In the following series of articles on the above subject the different railways are described in the order they have been examined, and no regard is paid as to which has been first executed.

The Taunus Railway.—(From Frankfort-on-the-Main to Mentz and the Wiesbaden.)

This railway derives its name from the Taunus Mountains, along which it extends; it connects the commercial city of Frankfort-on-the Main, with the steam navigation on the Rhine, the important city and fortress of Mentz, and the much frequented watering place of Wiesbaden, and passes through the territories of the free city of Frankfort, of Hesse Darmstadt and of Nassau. The Company for the construction of this railway was formed in 1836, and the capital of three millions of florins (or £250,000 sterling) subscribed; owing to the high value of the lands in this section of country, and the circumstance of the railway being located through three different territories, great difficulties were experienced in the procuration of the right of way, which, at the same time, has cost the Company an enormous sum. The construction of the railway was commenced in 1837; in September, 1839, the section between Frankfort and Hochst, of five miles, was opened for public use, and in April, 1840, the whole line from Frankfort to Mentz and Wiesbaden.

The principal object of the Taunus railway is the conveyance of passengers between the above mentioned places, and from its favourable position, it will always command a passenger traffic, and may be classed amongst the important and profitable lines of internal improvement in Germany. Frankfort, with a population of 50,000, is the centre of a considerable intercourse; there are constantly from 10 to 20,000 strangers in the city, coming from, and continuing their journey to, every part of the continent. Mentz contains 36,000 inhabitants, besides a garrison of 20,000 men; and the population of Wiesbaden is 12,000. The river Main, on which Frankfort is situated, and which empties itself into the Rhine at Mentz, is not navigable

Entered in the Patent Office
May 18th 1840

COL. LONG'S BRIDGES.

Fig. 1.

BRACE BRIDGE

Fig. 2.

SUSPENSION BRIDGE

for steamboats, owing to the shallowness of its water during summer. At Mentz the steamboats from the upper and lower Rhine meet, and the railway trains run in connexion with them. Still more important and prosperous the Taunus railway must become, when its projected continuation to Heidelberg on the one, and to Hanover and Hamburg on the other side, shall be executed.

The railway traverses a very interesting country. In passing over it, the Taunus Mountains are constantly in sight. It follows the course of the river Main to Cassel (or Castel) opposite Mentz, and then turns off to the right towards Wiesbaden. About midway between the latter two places a short branch leads off from the main line to Biebrick, the beautiful residence of the Duke of Nassau, on the river Rhine. There are many curves in the line of the railway, which, however, are generally very gentle, the smallest radius of curvature is 2,300 feet. The branch to Biebrick is connected with the main line by two short curves of only 328 feet radius. There is a straight line from Frankfort to Hochst, of five miles, and another from Hochst to Florsheim, of seven miles in length. The total length of the railway is as follows, viz:—

	Metres.		Miles.
From Frankfort to Cassel, - - -	33,329	or	20.70
From Cassel to Wiesbaden, - - -	8,620		5.35
Branch railway to Biebrick, - - -	1,434		0.89
	43,383		26.94

or very near twenty-seven miles.

There are, in the whole, forty changes in the gradients of the railway, which vary from level to an ascent of 28½ feet per mile. The railway descends from Frankfort to Wiesbaden, but undulates to conform with the natural surface of the ground.

The construction of this road resembles that of the English railways, of which it is an imitation. The excavations and embankments were made for a double track, the width of the road bed is twenty-four feet, and is divided as follows:

	Ft.	In.
From centre of road bed to centre of inner rail, - -	3	
From centre to centre of rail, - - - -	4	11
From centre of outer rail to edge of slope, - -	4	1
Half width of road bed	12	feet.

The clear width of the track is, as in England, four feet eight and a half inches; the bridges and culverts were all built of stone, with the exception of two over the fortifications at Cassel, which have a wooden superstructure. The longest bridge is that over the Nidda, which has three arches of thirty-three feet span each. The embankments, erected principally from earth taken alongside of the railway, are generally very low, the highest being twenty-nine feet; the deepest cutting is only thirteen feet. At an average, the Company has paid 2d. per cubic yard of earth excavation, and 9s. per cubic yard

of masonry. The wages of a common labourer were, at the time of the construction of the railway, from 10d. to 1s. per day; those of a mason, or carpenter, 1s. 6d.

The superstructure is made in the following manner:—upon the surface of the road bed is a layer of broken stone, or gravel, ten feet wide for each track, upon which are put stone blocks, where the railway is in cutting, or even with the natural surface of the ground, and cross wooden sleepers on embankments. The stone blocks are of red sand stone, brought from Ashaffenburg, in Bavaria, about forty miles from Frankfort, and measure twenty-six inches square by thirteen deep. Their sides parallel to the line of rails, five under each rail, (of 15½ feet in length,) but so that those nearest to the joints of the rails are two feet ten incnes from centre to centre, and those under the middle of rail, three feet three and a half inches. The wooden sleepers are of oak timber, half round and flattened on the top only, where the chairs rest, eight and a half feet in length, and seven inches high; they were put at the same distance from each other as the stone blocks. The price of a sleeper, delivered to the railway, was 4s. 6d., that of a stone block, 4s. 3d., or nearly the same. The iron rails are of a pattern similar to that on the London and Birmingham railway, weighing fifty-two pounds per yard, rest in chairs fastened upon every block, or sleeper, and are kept fast in the same by wooden filling pieces driven in outside the track. The chairs at the joints of two rails weigh twenty-four pounds, the intermediate ones, twenty pounds. A piece of felt is laid between the stone block and the cast iron chair, to diminish the bad effect occasioned by the roughness of the former. The space between the stone blocks, or sleepers, was filled out with broken stone, or gravel, up to the lower edge of the rail, and to a width of five feet on each side from the centre of the track. The remainder of the space between the gravel bed and the slope was filled up with earth to the same height as the gravel, with a fall of five inches to the slope. At intervals, from fifteen to thirty feet small channels were made in the banquette, and filled with gravel, in order to drain the foundation.

The Company has erected very spacious station buildings at Frankfort, Cassel, and Wiesbaden; shops for the repairing of locomotives, and carriages, are at Frankfort. Intermediate stations, where passengers are taken and left, are at Hochst, Hattersheim, Florsheim, and Hochheim. Water is always taken in at Hattersheim, and serves for two half trips.

There are at present, on the railway, six locomotive engines, from the manufactory of Robert Stephenson & Co., Newcastle-upon-Tyne; they have twelve (some thirteen,) inch cylinders, eighteen inch stroke, and six feet driving wheels; 100 passenger carriages of four different classes; the first and second class carriages are closed, and contain each eighteen seats, in three departments; the third and fourth class carriages are open on the sides, and have room for thirty to forty passengers. The carriages were manufactured partly in Hochst, and partly in Frankfort; the price of a second class carriage is £170, that of a third class one, £125.

Of the capital stock of the Company, (£250,000 sterling,) about £180,000 have been expended for the railway, buildings, fixtures, and material, which is at the rate of £6,667 sterling per mile. The chief engineer of this railway was Mr. Denis, who has also constructed the Nuremberg and Furth railway.

The Taunus railway has hitherto been used only for the transportation of passengers, and no arrangements have as yet been made for carrying also merchandize, &c. Since the road has been partly opened, in September, 1839, up to the 1st of July, 1840, the total number of passengers conveyed over the railway was 281,510, and the income £10,000 sterling. From April to July, during which period the whole line was in operation, the number of passengers has been 180,000.

There are daily five trips made between Frankfort and Cassel, and seven between Cassel and Wiesbaden, and the fares are, for a seat from Frankfort:—

	To Mentz.		To Wiesbaden.	
	s.	d.	s.	d.
In 1st class carriage, - -	3	6	4	6
2nd class " - -	2	5	3	0
3rd class " - - -	1	8	2	1
4th class " - -	1	2	1	5

The fare for way passengers is the same in proportion to the distance. From the above, it appears that the charge per passenger per mile, is:

In 1st class carriages, - - - -	2.08d.
2nd class " - - - -	1.38d.
3rd class " - - - -	0.96d.
4th class " - - - -	0.65d.

Each passenger is allowed forty pounds of baggage; for every pound exceeding this quantity he is charged at the rate of about 0.4d. per lb., or 3s. 4d. per 100 lbs. for the whole distance from Frankfort to Wiesbaden. The charges for over-weight of baggage are, therefore, as high as for the same weight of passengers in carriages of the first class!

In the whole management of the railway a great want of ability and experience is every where visible; which, however, must be attributed in part to the circumstance that the work is yet quite new, and the first established in this part of Germany, and that the individuals employed (of which there are rather too many,) are yet inexperienced in their new business. Although the station at Frankfort is only a quarter of an hour's walk from the centre of the city, the omnibus calls at the different hotels generally three quarters of an hour before the time of the departure of the trains. On arriving at the station, passengers procure their tickets at the office windows, and on presenting the same are admitted into a large room, where they have to wait in a crowd, until ten minutes before the time of starting. At the ringing of the first bell the door is opened, when they may walk over a large yard to the hall, (so called,) under which the carriages are arranged. Five minutes after, the second bell rings, which denotes that no more tickets are to be sold, and at the sign of the third and last bell the train departs.

At an average, there are from twelve to fourteen carriages in a train; with this load the engines travel at the rate of twenty miles per hour. The engine-men regard fourteen carriages as a full load for the locomotives, if they have to travel at that speed. The fuel used is coke, made from coal on the Rhine; the quantity used for a trip between Frankfort and Wiesbaden, twenty-three miles, is 1200 pounds, and the price is 2s. per 100 pounds, delivered to the railway. The expense for fuel is, therefore, per mile of travel, nearly 1s.

Sixty men are constantly stationed on the line, for the purpose both of watching and repairing the railway; they receive £1 10s. per month, and are divided in several parties, over each of which a superintendent is appointed. For the trips, the Company employed six engine-men, and two superintendents in the repairing shops. Ten conductors are employed to accompany the trains.

The branch railway to Biebrick has only been lately opened, and is used with horse power. Passengers coming up the Rhine by steamboats, and having the intention to visit Wiesbaden, may leave the Rhine at Biebrick, or continue their journey to Mentz, from both places a few miles travel over the railway will bring them to the celebrated watering place. A long floating bridge over the Rhine connects the city of Mentz with Cassel and the railway.

[TO BE CONTINUED.]

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. Boucherie, M. D.

[CONTINUED FROM PAGE 99.]

I have no where found any traces of a serious study of the causes which produce alteration in wood. It has indeed been said, in a general way, that wood is rotted, either because moisture and heat united, set it in fermentation, or because worms are introduced into the substance, where they are spontaneously developed and indefinitely multiplied. But to my knowledge, no one has examined whether the different elements of wood contribute equally to this fermentation and generation of worms, or whether some peculiar and perfectly distinct parts of its tissue are alone the cause of it.

I have applied myself to obtain by experiment some definite fact in reference to this, and my observations have resulted in this simple, but important principle; *that all the alterations which wood presents are due to the soluble matters which it contains.* They alone, in contact with a certain quantity of water, the action of which is aided by a proper temperature, have the power of becoming heated, decomposing and furnishing a corrosive liquid which penetrates the woody fibre, alters its structure, destroys its resistance, and transforms it into a substance, which, by final analysis, presents many of the characters of ulmic acid.

It is these soluble matters alone, which possess nutritive properties, and which aid the development of those numerous and varied animals which sometimes devour even the most compact woods.

The facts upon which this proposition is grounded, have been observed more particularly in oak. This wood, containing a large quantity of soluble matters, and producing strongly marked re-actions with the salts of iron, appeared to me likely to present the most appreciable differences, and to permit the most rapid experiments. My predictions have been realized, and I here give the results which I have obtained.

1. Oak wood, completely rotted, contains scarcely any soluble matters, and the proportion of these substances always follows the degree of alteration of the wood. The confirmation of this fact was obtained by means of washing saw-dust, of timber altered in different degrees. The waters used were concentrated, after mixing with a known weight of sand, which allowed them to be dried, without decomposition; and the weight of the soluble matters was determined by weighing the whole mass, from which weight that of the sand was subtracted.

The saw-dust from good wood gave me from five to six per cent. of soluble matter; that which was altered, gave less and less, descending to one per cent., and even to a fraction of one per cent. when the rot was general, and well advanced. In many of my experiments I confined myself to judging of the alteration of the wood, by the more or less energetic action which it presented, in contact with salts of iron. I traced upon a suspected piece, a line with a solution of a salt of iron, and the intensity of the colouring, indicated with sufficient exactness, in rotted wood, what was the degree of their decay. Some pieces, entirely decomposed, gave not a trace of tannin. I will mention, upon this occasion, that the study of the alteration of certain woods, conducted in this way, permits us to make some interesting remarks. I have thus recognized altered points disseminated in the midst of healthy parts, and long lines of decay placed between other lines which remained in their natural state. Such facts raise a doubt as to the homogeneousness of the tissue of wood.

2nd. If we take equal quantities of washed and unwashed saw-dust, equally dry, and moisten them with equal quantities of water, taking care to compensate equally in each case for the loss by evaporation, it always happens that after a certain number of days, that which was unwashed, becomes covered with a thick mould, while after six months, the washed saw-dust presents no indication of the kind. Examining their weight, after this lapse of time, we shall find that that of the washed saw-dust has remained the same, while that of the other has greatly diminished. I have not determined whether gases are disengaged during the process of alteration, but every thing leads me to believe, that by a proper arrangement of the experiment, I should have been able to detect the disengagement of gases, and determine the nature of them. I shall hereafter examine this fact, in every aspect of interest which it may present.

3rd. Finally, when we follow attentively, in the various channels which they bore in the wood, those large worms which destroy it so rapidly, we quickly perceive that they advance only by powdering the woody substance which they find before them, swallowing it, and

then discharging it either in the state of an impalpable powder, or in masses in which vestiges of fibrous organization are still found. The wood, before being traversed by this animal, yielded to water seven per cent. of soluble matter; after, it yielded a much smaller quantity, rarely amounting to two per cent.

I do not think it proper to swell the list of these facts with those I obtained from the examination of fruits and green stems. The conclusion to which I came, was, that since the soluble substances in wood, are the causes of the alterations which it undergoes, it is necessary, in order to preserve it, either to remove these soluble matters by some means, or to render them insoluble by introducing substances which will thus deprive them of their fermentable and nutritious qualities.

The removal of the soluble substances could only be effected by a species of washing, and although I judged it, a priori, to be impracticable, yet I desired to study the interesting facts which might be presented by experiments upon it, and to prove, by actual observation, the inefficacy of the process.

The following are the results of numerous experiments, into the detail of which it is not worth while to enter.

1st. That the penetration of wood, when plunged into water, is extremely slow, and that, for instance, pieces of oak three feet in length, and nine inches in diameter, continued to increase in weight after ten months maceration. Duhamel proved, a long time since, that parallelopipeds of two inches in height, by one inch square, did not become stationary in weight until after six months immersion.

2nd. That submerged wood discharged very slowly a portion of the soluble substances which it contained, and that this loss was sustained only by the exterior layers, even after a very prolonged submersion.

Having thus satisfied myself that the removal of alterable substances was not practicable, my next task was to seek the means of transforming them into insoluble bodies, in the tissue of the wood itself.

In order to arrive at a solution of this problem, I examined, in the first place, the re-actions which the soluble matters underwent by the action of various chemical re-agents, and when I had assured myself that all salts with an insoluble metallic base precipitated them abundantly, I sought for that, the two components of which should present the greatest advantages under the double aspect of preservative action and cheapness.

The impure pyrolignite of iron appeared to me to unite all the conditions desired.

1st. It is cheap.

2nd. Its oxide forms stable combinations with almost all organic matters.

3rd. Its acid has no corrosive properties, and is volatile.

4th. It contains the greatest proportion of kreosote which an aqueous liquor can dissolve, and it is not now doubted but that this substance protects, with great power, all organic substances against the alterations to which they are liable.

The facts upon which I rest, in declaring these properties, are of two orders—the first, indirect, have been determined from vegetable substances of a very alterable nature, or from saw-dust; the others from timber itself, and these latter present so strong a confirmation of the preservative qualities of the pyrolignite, that they may be already cited as conclusive and decisive.

I shall record them both.

1st. If we take vegetable substances of a very alterable nature; such as flour, the pulp of beets, or carrots, a melon, &c., (which differ from wood, which they resemble in origin and constitution, only by the greater quantity of soluble matters which they contain,) and after preparing them with the pyrolignite, by simple immersion, we leave them to themselves, alongside of similar substances, not thus prepared, and which, in other respects, are under similar conditions of surface, contact with air and moisture; we shall always remark, that if we have used a sufficient quantity of the pyrolignite, we will succeed perfectly in the preservation of these, while the others will exhibit the ordinary course of alteration. I refer to the first table for the detail of the results obtained from flour, and the pulp of beets, placed in contact with various chemical agents, or left to themselves in their natural state. This table may be used as a measure of the degree of protection exercised by various substances.

The experiments upon the melon are remarkable, and appear to me to give the strongest idea of the protective effect of the pyrolignite against the decomposition, which, in this fruit, is so rapid. In all my experiments I proceeded comparatively; the same melon was cut into two parts, one of which was immediately put upon a plate, and the other immersed in the pyrolignite, withdrawn from it after a few hours, and placed upon another plate alongside of the former. The unprepared parts always present the ordinary alteration—the prepared part had acquired a perfect unalterability; it slowly dried, and finally acquired the hardness of wood.

2nd. In treating wood saw-dust by the pyrolignite of iron in an unconcentrated solution, we observe results similar to those which I have just mentioned. In the oak saw-dust, the presence of tannin causes a very deep black tint to appear, which prolonged washing does not diminish. The oxide of iron forms a solid combination, and the greater part of it is found again in the ashes obtained from burning the saw-dust. Abandoned, when moist, to themselves, without preparation, they would have been rapidly covered with mould; the mixture once effected, they alter no more.

I have not been able to trace the slightest indication of alteration during an experiment which lasted six months.

This double fact, of the black colour, and the decomposition of the salt by organic substances, is much more marked in oak than in the white woods, in all of which, however, it is found, wanting only in intensity.

In reference to the question of economy, I was desirous of determining what quantity of the pyrolignite was absolutely necessary to render insoluble all the alterable elements of wood, and I have satis-

fied myself that one-fiftieth part of the weight of the green wood is more than sufficient to produce this effect. This determination was easily made by isolating these substances, by washing a known weight of saw dust, and estimating the quantity of the pyrolignite which it was necessary to add to it, in order to precipitate, completely, all the soluble substances upon which it could act.

I am convinced that among the numerous substances which constitute the soluble matter of wood, tannin and albumen are not the only ones which are rendered insoluble by the salts of iron, but I cannot as yet designate the others. I have undertaken a long examination of this subject, which has not as yet terminated; they alone constitute a work, the extent of which may be estimated by considering that it was necessary to begin by studying the matters themselves.

The direct facts obtained with the wood itself, are the subjects of experiment at the moment of writing this memoir, and in order to diminish the time of the experiment, I have selected a species of wood, much used, and especially employed for the hoops of barrels, which always rot in a short space of time.

This wood was penetrated by the pyrolignite by means of a process which I shall mention to the Academy directly. A committee was appointed by the prefect of the Gironde, to examine these experiments, and under their eyes, in December 1838, I caused to be placed upon the same casks, prepared hoops, and the best hoops of commerce, in their natural state. These casks were then placed in the dampest parts of the cellars. Already (10th of August,) a deep and complete decay is shown by the hoops in their natural state, while those which were prepared, have not undergone any sensible alteration.

I have the honour to submit to the Academy, the official report of this experiment. If the result is shown to be constant, by the prolongation of the experiment, that the natural wood has been for a long time worm-eaten, while the prepared wood has remained entirely untouched, I hope that we may be allowed to reason from chesnut to other woods, and to conclude, that there is great probability of success in executing important works with wood prepared by impure pyrolignite of iron.

I will not conclude without remarking, that, although I give the preference to the pyrolignite of iron as a preservative, I do not exclude certain neutral salts, much in use, such as the chlorides of calcium and sodium, (muriate of lime and common salt.) These salts are likewise very efficacious, but only in cases where the wood is not constantly wet. The sulphate of soda is also useful, although it acts in the opposite way from those which I have just named. I have observed, also, that it dries wood with great rapidity. Fearing lest the hopes which I had founded upon the pyrolignite should be overturned by direct experiments upon wood, I took care to prepare some dozens of hoops with the chlorides of calcium and sodium, either alone, or mixed with the pyrolignite. These hoops were also placed upon barrels, along with hoops prepared with the pyrolignite alone,

and abandoned like them, and during the same length of time, to the destructive action of the damp air of the cellars.

The preservation was as perfect as that of the hoops prepared by the pyrolgnite alone, and in addition, the flexibility was maintained as perfect as it was upon the first day of the experiment. From which I conclude that the preservative powers of the alkaline chlorides in wood, which is not constantly in water, equals that of the pyrolignite.

I shall shortly present to the Academy facts of the highest interest upon this subject.

[TO BE CONTINUED.]

On the Fermenting Capacities of the Sugars. By Henry Rose.

Translated for the Journal of the Franklin Institute, from "Poggend Annalen," for 1841' (Vol. 52, No. 2.)

In chemical and technical works, it is customary to divide the varieties of sugar into those capable of fermentation, and those which are infermentable. Among the former, are ranked cane sugar and grape sugar; among the latter, those derived from milk, manna, &c. We know, however, since Pallas' "Travels in Siberia," that milk sugar may be made to ferment, and that the milk of the cow, or mare, will readily afford intoxicating liquors by fermentation; and Schill and Hess have latterly proved, by experiment, that the crystalized sugar of milk is fermentable. It is highly probable that this sugar is first changed into grape sugar, which then causes fermentation, but the change is very slow, and even other substances, which cannot be ranked with sugars, such as starch, and several kinds of gum, but which contain oxygen and hydrogen in the same proportion as water, pass into the vinous fermentation more readily than sugar of milk, by the addition of substances containing nitrogen.

It appears that our elementary works neglect noticing the great difference in the fermentability of cane and grape sugar, and yet the circumstance is undoubtedly of great interest in the arts. It is the more remarkable as the difference is so striking, that we might be inclined to rank cane sugar with those incapable of fermenting.

If to equal weights of grape and cane sugar, dissolved in equal quantities of distilled water, we add small but equal, quantities of yeast, the solution of grape sugar often commences to ferment at a medium summer temperature of 16° R. (68° F.) while the other remains unchanged. While the fermentation of the former may be accomplished in a few days, the solution of the cane sugar may remain unaltered after the lapse of several months, even if the temperature should reach 77° or 100° Fahr.

The grape sugar employed in these experiments was perfectly pure, and of a white colour; the cane sugar was pure and crystaline. An ounce of each was dissolved in five ounces of water, and pure yeast added to the solutions. In order to employ equal quantities of the latter, it was always used of the same pasty consistency, so that two small tea-spoonsfull weighing 1.57 grammes, when dried in a water-bath, gave a horny mass, weighing 0.27 grammes. This quantity of

barm was entirely sufficient to induce rapid fermentation in the grape sugar, while it left the other unchanged, after the lapse of a month. Indeed it requires six times as much yeast to bring the latter to a slow fermentation, so that if it were required to ferment solutions of the two sugars equally, and in equal times, it would be necessary to employ seven or eight times as much yeast with the cane as with the grape sugar. Common brown sugar acts similarly to the refined, requiring a large quantity of yeast to induce fermentation.

In the fermentation of cane sugar, it evidently passes first into the state of grape sugar, and the larger amount of yeast which it demands is necessary to bring about this change. The capability of fermentation of cane sugar depends, therefore, on the same principles on which several kinds of gum and milk sugar are subjected to fermentation, under certain conditions. They are changed by the action of several agents first into grape sugar, which then undergoes vinous fermentation. But the cane sugar suffers this change more readily than all other vegetable substances, and hence it is usually ranked among fermentable sugars. It can, however, be no more considered as a substance capable of the vinous fermentation, than starch, the gums, or even sugar of milk, the latter substances, it is true, suffering the change more slowly, and with greater difficulty. Grape sugar is, therefore, the only fermentable variety, and indeed the only substance which can be decomposed by yeast into alcohol and carbonic acid, and all substances which suffer the vinous fermentation must previously pass into the state of grape sugar.

Liebig discovered that ammonia is present in the sap of many plants containing cane sugar, such as the maple and birch.* It has long been known to exist in the juice of the beet root. Possibly the ammonia, in its carbonated state, saturated the acid in the sap, thereby preventing the latter from converting the cane into grape sugar. For we find that the latter, and not cane sugar, is contained in the juices of all fruits, which possess both a sweet and acid taste. It is very possible, and indeed highly probable, that this sugar was at first contained in the juices as gum, or perhaps as cane sugar, and that these substances are converted into grape sugar by the gradual action of vegetable acid. If a sweet organic substance contains acid, the sweet taste must depend upon the presence of grape sugar. It appears that fixed organic acids induce the formation of grape sugar, for I found that the fermentation of cane sugar is more accelerated by cream of tartar than by any other substance. An ounce of cane sugar dissolved in ten ounces of water, and treated with two teaspoonsfull of yeast, as in the above experiments, began to ferment upon the addition of a drachm of cream of tartar; acetic, or sulphuric acid, did not produce the same effect.

* Chemistry applied to Agriculture and Physiology.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks Relative to the Fossiliferous Ore of Pennsylvania, and its Employment in the Manufacture of Iron. By Prof. J. C. Booth.

In the course of a recent tour on the Susquehanna, I had an opportunity of making a few observations relative to the iron manufacture, some of which I believe to possess sufficient value to be laid before those who are interested in this foundation of national wealth. Indeed it is desirable that a freer interchange of sentiment should be maintained on this subject, and as many iron masters have made important observations in the course of their practice, I would suggest to them that their own interest lies in communicating such knowledge to the public, by its inducing a reciprocity on the part of others; for competition is less to be feared in this manufacture than in all others, since the consumption of iron will increase, at least, in proportion with its production.

The hematites, and other ores of Pennsylvania, having been worked advantageously for a great length of time, I paid more particular attention to the "fossiliferous ore," which is beginning to be more appreciated than formerly, and for very good reasons. It is regularly stratified, easy of access, always lies in the vicinity of lime-stone, and is, in all probability, of very great extent. For a more full and comprehensive view of this deposite, I refer to the excellent series of Geological Reports, particularly the 2nd, 4th, and 5th, presented to the Legislature of Pennsylvania, by Professor H. D. Rogers, which are based upon the extensive series of observations made by that gentleman and his assistants.

At the Duncannon iron works, I was shown a portion of chilled iron, from the hearth stone of a furnace in which the soft variety of the fossiliferous ore had been employed. Beside pure silica, which separates, and appears sometimes to have suffered fusion in this situation, a considerable quantity of pure metallic titanium was disseminated through the iron, and in a few points, it had separated somewhat in the form of a crystaline efflorescence, in which the cubical form could readily be detected with a microscope, and in many cases, even with the naked eye. Upon referring to the analysis of this ore, (Report 2nd, p. 44; 4th, p. 191 to 195; 5th, p. 115 to 117,) no trace of titanium being mentioned, should not excite surprise, when we recollect the difficulty of detecting it, unless its presence should be suspected, and when we reflect on the small amount in the ore that might be requisite to precipitate an appreciable quantity of it on the hearth-stones. Beside, since this metal does not appear to combine with iron, nor to affect its quality, its detection in the ore is a matter of inferior moment, and I have merely introduced a notice of its presence from the interest with which it is regarded by those engaged in scientic pursuits. Another method by which it may be detected is to observe when the slag assumes a fine blue colour, for

Karsten has lately discovered that this colour of the slag is due to the oxide of titanium.

A few hints may not be considered irrelevant in regard to the reduction of iron, which occurred to me in observing the ordinary processes, particularly at Danville. In roasting ores, which is generally regarded as an important preparatory step to their reduction, it is inadvisable to employ too strong a heat, for then the earthy materials and metallic oxide enter into a state of incipient fusion, which can be but imperfectly reduced in the furnace, and generally flow to the hearth in the state of slag. For although the carbonic oxide will act reducingly on its exterior surface, the inner, being completely enveloped in a compact cinder, can scarcely be affected. Probably the hard siliceous ore requires less heat than most of the other ores of iron, and indeed I give it as my conviction, that if the cost be not too great, it would be infinitely better to subject it to a coarse pulverization by mechanical means, since there is so small an amount of volatile matter in it, that simple roasting will not render it sufficiently porous. If roasting the ore be still adhered to, nothing should be more strictly watched than the object in view, which is to drive off volatile matter, and render the ore brittle and porous, and nothing can be more injudicious than to apply a heat which will cause the ore to cake together, or become cindery, since it is then more difficult of reduction than the ore in its original state.

Another point that cannot be too much insisted on is the due and proper mixture of ores, and it might almost seem as if nature pointed out the propriety of this, in presenting the three varieties of ore in the same locality. It is a well ascertained fact, that a very large quantity of lime is requisite to bring silica into a fusible state, such as is necessary in the operations of the iron furnace, while a small proportion of alumina, in addition to those substances, requires less lime, and a much less intense heat, to form a perfect slag, or glass. Now it appears, from analysis, Report 5th, p. 116, that the siliceous ore consists almost wholly of peroxide of iron and silica, with only one-half per cent. of alumina, and that the calcareous variety contains none, and Report 4th, p. 192, the hard ore contains a mere trace of alumina. In Report 2nd, p. 44, the porous and soft ore contains five per cent. alumina, and in Report 4th, p. 191 and 192, a similar ore includes five and six per cent. of the same earth. Hence it appears that the chief deficiency of the hard and calcareous ores lies in the want of alumina, which is contained in the soft ores; and that they should, therefore, be mingled in due proportion. If it is not always practicable to obtain a sufficient amount of aluminous ore for this purpose, the importance of having alumina present is such that it would become advisable to employ an argillaceous lime-stone as a flux, or even to use a clay, or other argillaceous material. If these points were to receive the attention they merit, I am convinced that iron masters would not so often complain of the difficulty of reducing hard varieties of ore.

Architecture.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A Description of the Philadelphia County Prison, and the Debtors' Apartment. Designed and Executed by THOMAS U. WALTER, *Architect.*

The Philadelphia County Prison is situated on the Passyunk road, about one mile south of the city. It occupies a space of 310 feet front by 525 feet in depth, with an addition on the north of 150 by 340 feet.

The façade consists of a centre building of fifty-three feet in width, with receding wings on either side, of fifty feet, flanked by massy octagonal towers. Beyond these towers, receding wing-walls are continued to the extremities of the front, and terminated with embattled bastions.

The whole exterior is composed of a blue sienite, obtained from Quincy, in the State of Massachusetts.

The style of architecture is that of the castles of the middle ages, and its decorations are in the *Perpendicular* or *Tudor* style of English Gothic.

The centre building is three stories in height, diminishing at each story in regular offsetts, capped with a projecting belt. The corners are finished with circular warder towers of five feet four inches in diameter, commencing at ten feet below the top of the front wall, and extending five feet above it; these towers project *three-fourths* of their circumference over the corners of the building, and are crowned with embattled parapets, supported by corbiels. The front wall, and both the flanks, are also finished with battlements, pierced with embrasures, thus forming an embattled screen between the towers, and imparting a tower-like effect to the whole centre building.

The wings are two stories in height, and contain the gates of entrance, each of which is ten feet wide, and seventeen feet high. These wings, and the octagonal towers which flank them, are pierced with slip windows, and finished with embattled parapets, in the same manner as the centre building.

The bastions, on the extreme angles of the front, are also crowned with pierced battlements corresponding with the rest of the design. They project two feet from the wing walls, and measure, on each face, fifteen feet in width at the base, and thirteen feet at the top.

The centre building is surmounted by an embattled octagonal tower, which rises to the height of seventy-seven feet from the ground.

The interior is disposed in two general divisions, one for untried

prisoners, and the other for male convicts, whose term of service does not exceed two years; the female convicts being confined in a building on the adjoining lot.

The main prison contains 408 separate cells, built in two blocks of *three* stories in height, extending from each wing at right angles with the principal front. The cells open into a corridor of twenty feet in width, occupying the centre of each block, and extending the whole length and height of the building. The second and third stories are approached by means of granite stair-ways and galleries, supported on strong cast iron brackets; a clerk's office is situated at the head of each corridor, from which every cell-door in the whole range may be seen at the same moment.

Each cell is nine feet wide, thirteen feet long, and nine feet high, substantially arched with bricks, and floored with oak plank. They are all furnished with separate hydrants, water closets, flues for ventilation, flues for admitting fresh air, and flues for admitting warm air, generated in furnaces placed in the cellar of the building.

The furnaces are constructed at each end, and in the centre of each block, and the warm air is conveyed along passages of *three* feet in width, under the pavement in the corridor. The smoke flues are formed in these passages, the bottom and sides of them being composed of bricks, and the top, of cast iron plates; these flues extend horizontally from the main furnaces at each end, to the centre, where they rise perpendicularly to the top of the building; an ascending current is produced in the vertical portion of each flue by means of small furnaces constructed in the centre, and which are also made to impart heat to the cells adjacent to them; by these means an active current is formed in the horizontal flues, and heat is conveyed along the whole range, in sufficient quantities to keep all the cells of an agreeable temperature.

Each cell has a wooden door on the outside face of the wall, and an iron one on the inside; both doors are secured to a cast iron casing, or frame, which extends through the whole thickness of the wall.

The hydrants and water closets are supplied from *twelve* reservoirs placed near the roof of the building; these reservoirs receive their water from the works at Fairmount.

The kitchen, bake-house, laundry, and bath-houses, are situated in a separate building, occupying a space of forty-three feet wide by seventy-two feet long, in the yard between the two blocks of cells; they are approached from both divisions of the prison, by means of covered passages.

The kitchen is furnished with a large steam boiler, and four cast

iron reservoirs, of eighty gallons each, in which all the boiling for the prisoners is done by steam.

The apartment for females is situated in an adjoining enclosure, of 150 by 340 feet, entered by a gate-way from the yard of the main prison; the building measures 43 by 282 feet, and consists of two stories in height, embracing 100 separate cells, of eight feet by twelve, a suite of rooms for an infirmary, of twenty by fifty-one feet, and two rooms for a keeper, each twenty by twenty. The arrangements for hydrants, water closets, warming and ventilation, are similar to those already described.

The principal entrance to this portion of the establishment, is from Eleventh street; it consists of a gate-way of nine feet in width, placed in the middle of a projecting centre of fifty feet, composed of brown sand-stone, and finished in the simplest style of Egyptian architecture. The whole western front is built of the same material, and in the same style.

The Debtors' Apartment.

This edifice is situated on the Passyunk road, north of the main prison, and east of the female apartment; it presents a front of ninety feet, composed of brown sand-stone, in the Egyptian style of architecture. The façade consists of a recessed portico, supported by two columns, proportioned from those of the Temple of the Sun, on the Isle d' Elephantine, in Egypt. The windows are crowned with the massy bead and cavetto cornice peculiar to the style, and the top of the building is finished in the same manner. A winged globe is carved in the cavetto of the main cornice, and a similar ornament is introduced over the door.

The aggregate cost of the whole work was upwards of $450,000; the County Prison was founded in 1832, and finished in 1835; the debtors apartment was built in 1836, and the apartment for females in 1837 and 8.

T. U. W.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1840.
With Remarks and Exemplifications by the Editor.

1. *For a Galvanic Paint for Protecting Iron from Decay by Rust;* Lewis Knapp, New York, July 1.

This patent was taken for "a process in the manufacture of materials for galvanizing iron, or protecting iron from decay by rust, or decomposition." The specification is one of much length, and a general outline of the process would occupy more space than we can

allow to it; we therefore simply give the claims, which are as follows, viz. "What I claim as new, and of my own discovery and invention, is first forming of a galvanic paint for coating utensils of iron by pouring a mixture of lead and zinc, or lead, zinc, and tin, on a quantity of copper and sal ammonia, placed in the bottom of a vessel, so as to form an oxide of said metals, and afterwards combining with the oxide so formed, a further quantity of copperas and sal ammonia, as described. Second, I claim as new, and of my own discovery and invention, the combination of a portion of lime with the galvanic powder so produced, when such combination is used, for the purpose of economizing the galvanic powder, and making the paint so mixed, harder, and more adhesive. Third, I claim as of my own invention and discovery, the mode herein set forth, of forming an alloy of zinc and lead, or of zinc, lead, and tin, by pouring a mixture of said metals, in a melted state, on a quantity of copperas and sal ammonia, which unites with the grosser parts, and allows the purer parts to escape through the bottom of the vessel, as described."

This compound is manifestly empirical, and must be inferior in its protective influence to the paint claimed under M. Sorel's patent, whilst if it possesses any good properties they are due to the same cause which gives value to the latter.

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2. For *Making and Attaching the Heels of Boots and Shoes;* Samuel Warner, of Lowel, Vermont, Jere Hodgkin, of Westfield, Vermont, and William E. Truver, Watervliet, New York, July 1.

The improvement consists in making a hollow shell of the form of the heel, either of metal, horn, bone, or ivory, which is to be attached to the boot, or shoe. The inside of this shell is to be filled up with India rubber, cork, leather, or other elastic substance. About midway between the bottom and top of the shell there is a flanch, by which it is screwed to the leather of the heel of the boot, or shoe.

The patentees say, "What we claim as our invention, and desire to secure by letters patent, is the manufacturing and attaching metallic, horn, bone, or ivory heel cases, the hollow part below the flanch to be filled up with India rubber, cork, or leather, or any other suitable material, and combining therewith, or attaching thereto, a spur, when necessary."

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3. For *Coupling Irons for Preventing Railroad Carriages from Running off the Track;* Thomas G. Owen, Baltimore, Maryland, July 1.

The coupling irons, which are the subject of this patent, are each made of two pieces, jointed together at one end, like a carpenter's rule. The holes through which the coupling pins pass are drilled through when the two pieces are closed, so that one-half of each hole is in each half of the coupling irons; one of them is made near to its jointed end, and the other at the distance of a few inches from the opposite end. When the coupling iron is in place its two halves are held together by the passing of that end which is not jointed, into a

mortise in a sliding bar, by which the two parts are held together whilst the two cars are in a line with each other, or whilst they deviate no further from this than is occasioned by the curvature of the track. But should the locomotive, or a forward car, run off the track, the coupling bar will be released from the mortise in the sliding bar, and its parts will separate from each other, and disengage the cars. The claim is to "the method of coupling railroad cars, or carriages, by means of the double coupling irons, in combination with the sliding bar, for the purpose, and in the manner, substantially, as herein described."

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4. For *Arranging the Cylinders of Steam Engines, so as to Prevent the Dead Point in the Crank;* Caleb L. Ferris, Courtland, West Chester county, New York, July 1.

The patentee says, "What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the horizontal and vertical cylinders, that is to say, I claim placing said cylinders (whether one be horizontal, and the other vertical, or otherwise, providing their relation to each other be still the same,) at right angles, or nearly so, with their closed ends adjoining each other, and the crank, or main shaft between them, at the junction of the angle, and operating the cranks by means of having the connecting rods of both cylinders attached to them."

The placing two steam cylinders, with their axes at right angles, has been heretofore done, and with the same object in view as that above stated; but the novelty, in the present instance, consists in the placing the two closed ends, or what usually constitutes their bottoms, close to each other, with the crank shaft so situated as to occupy the space between said closed ends. From the crank, or rather cranks, connecting rods extend to the pistons of each cylinder, in the ordinary way. By the above arrangement a great part of the room is saved, which was uselessly occupied by the connecting and operating parts, on the former plans of placing the two cylinders; so far, certainly, this may be considered as an improvement.

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5. For *Door Springs;* Gardner Barton, Sr., Shaftsbury, Bennington county, Vermont, July 1.

This is a spring for closing doors. A standard is attached to the upper part of the door, having a roller on the upper end of it, which roller acts against a lever attached to a segment of a cog wheel. The segment cog wheel turns on a pin, which connects it to a bar attached to the casement above the door, the segment mashes into a rack, which has a rod at one end of it, around which a spiral spring is wound. The spring is attached by one end to the bar, and by its elasticity forces the rack out, and acts upon the segment and lever, the latter of which, by bearing against the roller on the standard attached to the door, keeps it closed. The claim is to the combination and arrangement of the spring rack, segment, and lever, and the roller attached to the standard.

6. *For a Portable Railway for Removing Earth, &c.;* Jarvis Ring, Ogden, Monroe county, New York, July 1.

This portable railway is for removing earth, or other articles, to a short distance, and depositing it at one end of the railway. The description is given at great length, but the purposes to which it is to be applied are not very distinctly set forth. The cars, or trucks, are to run upon rails, extending the length of the apparatus, and are to return in an inverted position, under these rails; in order to enable them so to do, the ends of the upper rails are rounded, so as to form a semicircle, and around these the cars, or trucks, pass; when they have so passed, the wheels are supported on under rails, along which they return to the opposite end of the portable railway, where they ascend, by passing round a semicircular curve, and are ready to be re-loaded. The truck, or cars, are jointed, and otherwise so constructed as to enable them readily to pass round the semicircular ends of the track; they are connected together by a band, and motion may be given to them by means of a winch, or crank. The whole structure must, of course, be sustained by suitable frame work. The claim is to "making a double railway, with one track above the other, and rounded off at the ends, to unite the two, so that cars attached to endless chains, or belts, can run upon the two tracks."

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7. For improvements on the *Cylinder Mill for Grinding Corn;* Harvey W. Pitts, Wilsonville, Shelby county, Alabama, July 1.

Two cylinders of stone are placed side by side, and made to revolve with different velocities. Their axes are horizontal, and a double concave of stone is made to occupy the space between them on their upper sides, thus forming a rubbing surface between the concaves and each cylinder, equal to about one-fourth of its surface. A vibrating motion is given to the concave by means of a cam, or otherwise, and it is borne up against the cylinders by suitable means. The claim is to the "double vibrating concave, in combination with the fast and slow moving cylinders."

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8. For improvements in the *Steel Writing Pen;* David Thomas, Hingham, Plymouth county, Massachusetts, July 3.

These improvements in the steel writing pen consist in a peculiar mode of making the pen in two pieces, so formed as to give the elasticity above the nib, instead of to the nib itself; also in a manner of sustaining and securing the pen in the holder by means of set screws, and likewise in covering the holder with leather, gum caoutchouc, or any other elastic substance. Without the drawings the claim could not be understood; and we are apprehensive that the pens themselves will not pass into the hands of many of our readers.

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9. For a *Machine for Drilling or Boring Rocks;* Simon Petter, Schenectady, Schenectady county, New York, July 3.

The drill stock slides in bearings in a frame, which frame slides up

and down, in an inclined frame, the respective parts being made adjustable in such manner as to give to the drill any desired inclination. The first frame slides in grooves in the inclined frame, and its height is regulated by cords attached to it, and passing over a roller at the top of the inclined frame. The inclination of the inclined frame is regulated by passing the screw bolts, by which it is secured, through long slots in the upper and lower side-pieces of the main frame—the upper bolts also pass through slots in the side-pieces of the *inclined* frame, to allow for the increased distance between the upper and lower bolts, when the inclination of the frame is increased. There is a circular plate on the drill stock, the under side of which is provided with cogs, or cams, which are tangential to a circle about half the diameter of the plate, so that when the tappets, by which the drill is worked up and down, act against these cogs, or cams, in lifting up the drill, it insures the turning of the drill. The claim is confined to the combined adjustable and sliding frames, with the drill, and to the method of raising and turning the drill, by means of the cogs, or cams, on the plate, and the tappets.

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10. For an improvement in the *File for Filing Papers;* William Mann, Philadelphia, Pennsylvania, July 3.

This file, for letters and papers, consists of two covers, like those of a book, at the back edge of each of which there is a thin plate of iron—one of these plates is provided with two holes, to pass on to two screws attached to the other. The papers to be filed are placed between the two covers, and by means of nuts and screws, the whole is so compressed as to hold the papers. The nuts are halved, and each half is attached to a spring, the two springs being united together at their upper ends, in the manner of a crayon holder, and the two half nuts are brought together when it is desired to screw the file tight, by means of a slide, in the manner of closing that instrument. As the screws are necessarily very long, the nuts may be put on and taken off, by opening and closing the slide, so that they are not required to be turned on the screws, excepting to tighten and loosen the file.

The claim is to the "construction of the divided spring screw nut, opening by the elasticity of the springs attached to the two halves, and united at top, and made to close by means of the sliding ring, and adapted to the file, in the manner described, for filing papers and letters."

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11. For a method of *Attaching Artificial Teeth;* Alfred Riggs, City of New York, July 3.

The claim upon which this patent was granted, fully expresses the nature of the invention, and is as follows. "I rest my claim to invention, or improvement, in the making, or manufacture, of boxes, or plates, for mounting artificial teeth, upon the making, or forming, them of two parts, or plates, closely united together at the edges, so as to be air-tight, with a space, cavity, or hollow, between the plates,

either continuous, or divided into apartments. The inner plate, which rests upon the gums, being perforated with holes, more or less in number, through which the air is exhausted from the space, hollow, or cavity, between the plates, by suction, or otherwise, thus causing the boxes to adhere to the gums, by the pressure of the atmosphere, or air from without."

Perhaps teeth may be firmly held in this way, but to us it seems very doubtful, and most certainly, as a general mode, it cannot be applicable, the state of the gums and teeth, in most subjects, not admitting of such a mode of fastening.

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12. For improvements on the *Roller Gin for Ginning Cotton;* Fones M'Carthy, Demopolis, Morengo county, Alabama, July 3.

In front of the rollers there is a plate, which extends their whole length, and vibrates up and down; its upper edge is serrated, and is called by the patentee, "a vibrating saw;" immediately above this saw is an adjustable plate, which can be moved up and down, to regulate the distance between its lower edge and the vibrating saw. The bottom of the hopper, which is to contain the seed, lies directly in front of the adjustable plate, is horizontal, and is grated. The drawing roller is placed behind the vibrating saw, its upper surface being on a level with the saw—it is covered with leather, has a spiral groove running around it, and has a weighted roller above it. Behind this last named roller is a receiving roller, which is covered with cloth, and around which the cotton winds after it leaves the drawing roller; a vibrating comb placed behind this strips the cotton therefrom. As the cotton is drawn between the adjustable plate and vibrating saw, by the draw roller, the vibrating saw loosens and strips the seeds. The claim is limited to the "arrangement of the vibrating saw, adjustable plate, and grooved drawing roller, for separating the seeds from the cotton, in combination with the receiving roller and comb."

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13. For *Applying Distemper Colours in Painting, &c.;* Francis Gybbon Spilsbury, Fawny Corhaux, and Alexander S. Byrne, of Great Britain, July 10.

The patentees say, "The object of our invention, whether in preparing pigments, or paints, and vehicles, or in the mode of applying them, relates to means of using soluble vehicles for applying paints, or pigments, which vehicles, by an after application of chemical agents, or re-agents, are rendered insoluble in water, and will thus allow of paints, or pigments, so applied, and so fixed, to be afterwards washed, in order to clean them, and will, at the same time, admit of paints, or pigments, and vehicles, so employed, being applied for the most elegant purposes of house, and such like, painting, and also to the purpose of the artist, and for printing paper, and other fabrics, and, at the same time, in their use, they will not emit that disagreeable smell consequent on using oils, or spirits, or varnishes"—again, in giving the rationale of their invention, they say, "It is well known

that many chemical agents, or re-agents, when brought in contact with gelatin, or albumen, in solution, coagulates them, and such coagulated substances, when dry, are insoluble, and such is the case with other matters which, as well as gelatin and albumen, are employed as the soluble vehicles for mixing with pigments, in order to their being used as paints, and by the subsequent application of chemical agents, or re-agents, such vehicles are rendered insoluble, and the paints, or pigments employed, fixed, or set."

When gelatin is used as the soluble vehicle, alum is employed to fix, or give permanence thereto, the patentees deeming this the best of the chemical agents for rendering gelatin soluble in water.

The extracts above given will afford a good general idea of the nature of the invention, and as the specification and claims are of great length, and the latter not descriptive without the former, we omit them.

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14. For *Stoves, or Air-heaters, for Heating Apartments;* George C. Howe, City of New York, July 10.

A semi-cylindrical drum surrounds one-half of a cylindrical fire-chamber, leaving a space between the inside of the drum and the outside of the stone. On each side, near the top, a short pipe connects the chamber of combustion with the semi-cylindrical drum—another pipe passes directly through the back to the chimney, and an elbow pipe connects the bottom of the semi-cylindrical drum with the pipe that leads to the chimney beyond the valve employed therein, to close the direct draught. When the valve in the pipe that leads to the chimney is opened, the draught passes directly out; but when it is closed, and a valve, in the pipe which leads to it, is opened, the draught passes out on each side into the drum, and thence through a pipe into the exit pipe. The air of the room circulates through the space between the fire-chamber and drum, and thus becomes heated. The claim is to the manner in which the cylindrical stove and drum are combined, "by making the drum surround the back part of the cylinder, and leave an open space between it and the latter for a current of air to circulate through, as described." "And also to the arrangement of pipes and valves, in combination with the above."

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15. For a method of *Hanging Doors;* William D. Beasom, and E. G. Reed, Assignees of George W. Wilson, Nashua, New Hampshire, July 10.

The upper hinge of the door is to be made with two tongues on one half of it, and with one on the other half; the hole through the latter is made conical from either end, so that the pin attached to the two horns of the first named half, will be allowed some play. The lower hinge is made with a pivot on the half attached to the door, which rests in a socket in the other half; and this pivot, instead of being plumb under the axis of the upper hinge, stands out some distance, so that the weight of the door will always tend to close it, un-

less it be opened beyond a right angle, when it will have the opposite tendency.

The claim is to "the construction of the upper hinge in combination with the lower hinge, arranged and operating together." The particular arrangement claimed has some novelty, but the general plan is old, doors, and particularly gates, having been frequently hung upon this principle.

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16. For *Making Card Paper;* Edward L. Perkins, Boston, Massachusetts, July 10.

The machine used by the patentee, consists of an arrangement of rollers which carry a sheet of paper over a revolving brush, which brush receives the paste from a bed, which is supplied from a reservoir; this brush spreads the paste on the sheet, and another brush takes off the surplus, the paper is then carried to two pressing rollers, where it is united to another sheet of paper, which comes from a roller above. The claim is to the particular arrangement of the respective parts of the machine, referring to the drawings, and not capable of being understood without them.

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17. For *Boxes for Carriage Wheel Hubs;* Nathaniel C. Day, Lunenburg, Worcester county, Massachusetts, July 10.

The washer, or shoulder, of the arm of the axle-tree, against which the inside of the hub is to bear, is made conical, its greater diameter being towards the hub—a cavity is made in that face of it which is against the hub, for the reception of grease, which, when the axle-tree becomes heated, supplies grease to the rubbing parts. The box is provided with a cylindrical flanch, which extends over the washer, or shoulder, on the arm; and over this extends a *gravel guard,* which is a semi-cylindrical hoop, attached to the bed piece of the axle-tree. The patentee says, "what I claim as my invention, and ask a patent for, is the combination of the conical periphery of the washer, the grease reservoir, the flanch of the box, and the gravel guard, as above described."

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18. For *Preventing the Escape of Sparks from Locomotive Steam Engines;* Francis B. Longmire, and H. Jones Brooke, Philadelphia, Pennsylvania, July 10.

The patentees say, "In the apparatus which we have invented for preventing annoyance from sparks, we make use, as is usual, of the escape steam, for the purpose of creating a draught through the fire; but instead of extending the waste steam pipes upwards, into a vertical flue, in the ordinary way, we carry said pipes downwards, so as to pass within a flue under the boiler; said flue may extend along, into, or below, the ash-pit, under the fire-box, so as to cause the sparks, with the waste steam, and the gaseous products of combustion, to be discharged into a compartment prepared therefor, or into the ash-pit, allowing their final exit to be downwards, on to, or towards,

the ground. For the purpose of economising heat, we, in general, construct a metallic water box, or chamber, made flat, enclosed on all sides, and of such size as to occupy the area of the fire box, and this, by means of suitable tubes, we connect with the water tank, so as to allow water to flow into it; and we also connect with it the tubes of the supply pump, so that the water flowing in from the tank on one side, and heated to a considerable extent by the heat from the ash-pit, and from the escape steam, on its passage to the opposite side, may go to supply the boiler."

"Having thus fully set forth the nature of our invention, and shown the manner in which the same is to operate, what we claim therein, and desire to secure by letters patent, is the extending of the exhaust steam pipes downwards, and into a flue passing horizontally along under the boiler, into a compartment in the lower end of the fire box, which compartment may consist of the ash-pit, or of one specially prepared for the purpose, substantially in the manner set forth. We also claim the manner set forth, of locating and using a water box, constructed in the way, and employed for the purpose herein set forth."

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19. For a method of *Making and Attaching Buttons;* Festus Heyden, Waterbury, New Haven county, Connecticut, July 10.

The button is made in the manner of the common brace, or suspender button, except that there is but one hole in the middle of the concave part; and it is attached to cloth by means of a broad headed rivet, the shank of which is put into the hole from the back, and riveted on by means of a concave punch. The claim is in the following words, viz. "I claim the method of attaching buttons to cloth by riveting, and of manufacturing the parts for that purpose, combined in the manner, substantially as specified."

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20. For *Wooden Pavements, and Building Horizontal Platforms;* Redwood Fisher, of New York, Assignee of Augustus Count De Lisle, Paris, France, July 10.

The blocks are shaped to represent two parallelopipeds crossed diagonally, so that the two upper and two lower sides may be upon the same plane, and the top and bottom parallel to each other, or two parallelopipeds may be united together to represent the same forms. These may be made of iron, stone, wood, or of any other suitable substance. The blocks thus formed, are placed in ranges, so that the two extreme angles of the parallelopiped of one block will overlap those of a block in the next range. In forming beams, two, or more, ranges are put together, from one abutment to another, the middle or key block of each range being formed of two equilateral triangles placed side by side, an angle of one, and a side of the other, being upwards, and the other reversed. The inclinations of the parallelopipeds being inclined in opposite directions from the key towards each abutment. It is not possible to give a clear idea of this arrangement without drawings. The claim is, first to the "mode of forming

or shaping, materials, or substances, for building, paving, and other purposes, according to the divisions of the cube herein described; and secondly, to the mode of employing, in combination for building, paving, and other purposes, blocks, materials, or substances, so formed, or shaped."

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21. For a *Refrigerator;* John Scott, Philadelphia, Pennsylvania, July 10.

The patentee says, "I construct my refrigerators principally, or entirely, of sheet metal, and make them either in the form of a parallelogram, a vertical cylinder, or oval, or in any other shape that may be preferred. In whatever form I make them, they are to consist of two cases of sheet metal, one placed within the other, so as to leave a space of an inch, more or less, between the two, which space may be occupied by air, or may be filled in with any fibrous, or pulverized, bad conductor of heat. My principal improvement in such refrigerators consists in my forming a chamber for receiving ice, in the upper part thereof; and a second chamber for the reception of the water produced by the melting of the ice in the lower part, with suitable openings for the passage of the water from one chamber to the other, by the descent of which cold water every part of the apparatus is cooled."

"What I claim as new, is the forming it with an upper and lower chamber, in the manner described, the upper chamber being intended to contain ice, and the lower to receive the water produced by the melting thereof, said water descending from the upper to the lower chamber through tubes, or channels, constructed substantially in the manner set forth, so as, in its descent, to exert its refrigerating influence within the refrigerator."

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22. For *Truss Frames of Bridges;* William Howe, Warren, Worcester county, Massachusetts, July 10.

The following are the claims on which this patent was granted, viz: "What I claim as constituting my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the braces and counter braces, the double posts, and the wedges between them, so that by the driving of said wedges the truss frame may be cambered in any desired degree; I claim the manner of carrying the same principle into effect by the combined operation of the wedges, or keys, over the arch beam, and those between the posts. I claim the application of the same principle by an arrangement of braces and counter braces, combined with an arch beam, the wedges, or keys, for cambering, being driven between the principal and resisting braces, in the manner set forth, together with such other modifications, or variations, of the same principle by which the same end may be attained, by means substantially the same."

In the first modification claimed, the posts, along the truss frame, are double, and the braces and counter braces run from one half post to the half post of the second section, crossing by the side of the two

half posts that form the division between the first and second sections; and the second set of braces and counter braces start from the half posts crossed by the first braces in either direction, and so on. Strings, of course, embrace the whole on both sides. The wedges for cambering are driven in between the double posts.

In the second modification, the posts are split from the top nearly to the bottom, the wedges being driven in at the top. The braces and counter braces extend from the bottom of one post to the bottom of the next, in each division. An arch passes through the truss from end to end, embraced, or straddled, by each post, and a key is used where each post rests on the arch, so that by driving the keys on the arches, and those in the split posts, the frame is cambered. In the third modification, the braces and counter braces, instead of reaching from post to post, in each division of the truss, nearly meet in the middle, and the wedge is driven in between them, to give the camber.

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23. For a *Water Wheel for Driving Mills;* Joseph Hanchett, Cold Water, Branch county, Michigan, July 15.

The wheel referred to is a modification of the well known paddle wheel, in which the paddles are always kept vertical, by an eccentric guide wheel, or disk, at the side of the main wheel, the axis of each paddle having a crank, which works in the eccentric guide wheel, so that as the main and guide wheels revolve together the paddles enter and leave the water vertically, instead of radially. That which the patentee claims as an improvement consists of a method of changing the relative position of the main and guide wheels, so as to make the paddles enter and leave the water at a given inclination; and this is effected by having the shaft of the main wheel suspended in stirrups attached to two short shafts, on one of which the guide wheel works; on the end of these shafts are the levers, which change the position of the stirrups, and consequently the main wheel, relatively to the guide wheel. The line of the paddles will always be parallel with a line passing through the centre of the guide and main wheels.

The claim is as follows, viz: "What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the guide wheel upon the short axle, in combination with the main wheel, as suspended in stirrups fixed to the ends of short axles, turned by levers, for changing the position of the centre of the water wheel, in order to change the angle of the paddles, all as herein described." This, we suppose, will be just as good as some of the numerous analogous contrivances which have been made the subjects of patents, but neither of which has yet superseded the ordinary wheel, or even placed it in jeopardy.

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24. For *Dressing Staves for Making Barrels;* Hervey Laws, Wilmington, New Hanover county, North Carolina, July 15.

This machine is intended for the dressing of rived staves, or of such as may be made from saw-mill slabs. The pieces to be dressed are to be cut to a suitable length, and they are delivered from the machine

of the proper convexity and concavity on their sides, and with their edges jointed. The staves are dropped, or fed, into the machine through a suitable opening, and by means of a follower, worked by a crank motion, the stave is first forced along a trough-like cavity, between knives, or cutters, for the purpose of removing all superfluous stuff, and passing on, it is then forced between, and against, a series of cutting irons, operating as plane irons, and held in stocks by wedges, or otherwise; one set of these irons give to it its proper convexity, and the other its concavity. From this part, which dresses its sides, it passes on to the part where its edges are to be jointed; and this consists of a curved trough, continued on from the straight part, last described. The curvature of this jointing trough is such as will allow the stave to pass without bending it, but with its middle against the convex, and its ends against the concave side of the trough, and in thus passing it is jointed by a series of plane irons acting on each of its edges, in such manner as to give the proper rake to the joints, and the proper bulge to the stave. Each stave is forced on by the one immediately behind it, and they are delivered in a finished state with great rapidity. There are but few machines for the same purpose which are so truly original, and so far as we are informed, but few the action of which is so perfect.

The patentee says, "what I claim as constituting my invention, and desire to secure by letters patent, is the manner of constructing and combining the part for dressing the faces of the staves, with a curved box, as set forth, and furnished with a series of jointing irons contained in stocks forming the upper and lower portions of said box; the faces of said plane stocks approaching each other on the concave side of the interior of said box, for the purpose, and operating, substantially, in the manner herein set forth." "I also claim the said curved box for jointing staves, in its individual capacity, the respective parts thereof being constructed and connected, as herein described."

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25. For an improvement in the process for *Manufacturing Fair Leather;* John L. Turner, Philadelphia, Pennsylvania, July 15. (See specification.)

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26. For an improvement in *Fire Chambers for Stoves;* Benjamin F. and Job S. Gould, New York City, July 15.

These fire-chambers are of cast iron, and are fluted on their outsides like the shaft of a column, and their inner surfaces correspond in form with their outer, as they are of equal thickness throughout.

The patentees observe that "by the yielding nature of the arches, (swells, or ridges,) and the transmission of the same caloric through the sides of the chamber with diminished intensity of heat, owing to the additional extent for this transmission, without injury to the draught, the iron will be rendered far more indestructible, effecting an improvement which cannot be attained by any other mode."

The claim is to that mode of constructing the chamber of combus-

tion, or what is usually denominated the cylinder of a stove, with flutes, or ridges, as above described.

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27. For an improvement in the *Planing Machine;* James M'Gregor, Jr., July 15.

This improvement is made on a planing machine originally patented on the 28th day of August, 1833, and noticed in vol. xiii of this Journal, page 120, and on which a patent was obtained for further improvements, on the 9th day of January, 1838. A clear idea could not be given of the present improvements, excepting to a person well acquainted with the machine as formerly constructed; but the following extracts from the specification will afford some general idea of their object.

"My first improvement consists in a gauge for setting the irons when they are to be replaced after being removed, for the purpose of sharpening, by means of which gauge they are at once set to the proper rake and rankness, so as to require little, or no, further adjustment." "My second improvement is in the manner of constructing the sliding frame which governs the grooving saw." "I claim first the construction and use of the gauge for adjusting, or setting, to the proper rake and rankness, the cutting, or plane, irons; the same being made as described. Secondly, I claim the combining with the original sliding frame of the grooving saw of my planing machine, the adjusting frame, screw, and nuts, in the manner, and for the purpose set forth."

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28. For a *Log Brace for Saw Mills;* Benjamin Cushwa, Clear Spring, Washington county, Maryland, July 15.

"My log brace consits of a shaft supported on gudgeons, and crossing the floor of the mill beneath the carriage, at a short distance in front of the saw, said shaft having standards mortised into it, which support a friction roller, intended to sustain the log whilst being sawed. From this shaft there also extends an arm, by which the shaft and roller are held in place, and which arm is raised, and the roller lowered, as the rear end of the log approaches the saw."

"What I claim as constituting my invention in the within described improvement in saw mills, is the manner of using the shaft, carrying the friction roller for supporting logs on saw mills; the several parts connected therewith being combined together, and operating, in combination with the carriage."

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29. For improvements in the *Universal Chuck for Lathes;* Simon Fairman, Waterford, Saratoga county, New York, July 18.

This universal chuck is of the kind in which the holders, or pieces, which confine the articles to be turned, are moved simultaneously towards, or from, the centre of the chuck, by means of a convolute groove on a plate at the back. The first improvement is in the mode of uniting the front and back plates by means of a tube which projects from the back of the front plate, and unites it to the back plate,

the two being held together by a nut which screws on to the end of the tube. The inside of the tube is provided with a female screw to screw on to the mandrel. Whilst the chuck is on the mandrel the nut may be loosened, which will allow of the revolving of the back plate, on which is the convolute groove, to work the holders. The second improvement is in making openings in the outer rim attached to the front plate, through which that part of the holders, which slides in the plate, may pass, so that that part of the holders may be made long for a steady bearing, and be allowed to pass out through those holes in the rim, when any thing of great diameter is to be turned. The following is the claim. "I do not claim to be the inventor of the above described mode of working the holders by means of the convolute groove; but what I do claim as my invention, and desire to secure by letters patent, is the method of securing together the front and back plates, by means of the tube and nut, by which I am enabled to attach the front plate directly to the mandrel, or face plate, of the latter, all as above described. In like manner, I do not claim as my invention, the rim on the front plate, but what I do claim as my invention, is providing the rim with apertures, through which the slides, or holders, can pass, for the purpose, and in the manner above described."

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30. For an improvement in the *Parlour Grate, or Open Fire-Place;* Charles R. Wheeler, Boston, Massachusetts, July 18.

In this grate the jambs are made hollow, and divided into two flues, in order to cause the draught to ascend in one division, and to descend in the other; a cylinder, which runs from bottom to top, constitutes a part of the partition, and through this the air of the room circulates, and becomes heated. The claim is to "the construction of the hollow jambs, by making each of them with a vertical division plate, so as to conduct the smoke down on one side, and up on the other, in combination with the cylinders placed between said flues, for the purpose of heating the air of the room, as described."

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31. For improvements in the manner of *Constructing Kitchen Ranges;* Ebenezer Barrows, Rochester, Massachusetts, July 18.

The fire-chamber of this range consists of a cast iron cylinder placed within the square chamber generally employed in kitchen ranges— on each side of the fire-chamber there is an oven, the side plates of which are provided with an opening, to allow the heat to be radiated through this opening directly into the ovens, as the flues do not pass around them.

The claim is to the "manner of constructing and combining the three compartments constituting the fire-chamber and the side ovens, there being a free opening for the radiation of heat from the fire-cylinder contained in the former, into said side ovens, the latter being without flues around their sides, and their ends being formed of brick."

32. For improvements in the machine for *Cutting Match Splints;* John H. Stevens, Assignee of Elisha Fitzgerald, New York City, July 18.

This machine consists of a horizontally sliding gate, operated by a crank and connecting rod, and this is provided with a number of gauge teeth attached to a plate at one end, and a knife attached to it diagonally, extending from end to end. Above the knife-gate there is a box, in which the block, to be cut into splints, is placed, said box being provided with the necessary apparatus for holding, and for feeding, the block as the splints are cut off. At each stroke of the gate the gauge teeth pass under the block, and divide it into widths equal to the width of a match splint, and the knife then follows with an oblique draw cut, and takes off a plate as thick as the match splints. Each plate, thus cut off, having been previously divided and cut by the "gauge teeth"—the splints are thus completed. The claim is as follows:

"I do not claim as my invention any of the parts of the aforesaid machine, separately, and independently of their combination in said machine; nor do I claim as my invention, or improvement, any of the combinations in the above machine other than such as I have above specially named and claimed. But I do claim as my invention and improvement, the knife, having a diagonal drawing stroke, in combination with the points used as gauge teeth in cutting off and separating match splints by one operation, as described."

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33. For a *Machine for Planting Cotton Seeds;* Levin Miner, and Nicholas Felts, Yanceyville, Caswell county, North Carolina, July 18.

In this machine the planting is effected by a wheel placed on the axis of that on which the machine is sustained; the planting wheel has teeth on its periphery, which draw down the seeds from the hopper. The hopper consists of three parts, viz., a board, or piece of wood, having a square hole through it, and which is fixed to the beam directly over the planting wheel; the second part consists of a leather spout, the lower end of which is attached to the above named board, around the square hole; and the third part is in the usual form of a hopper, and is attached to the upper part of the leather spout. This third part is suspended by two cords from two springs to allow it to have a swinging motion, by which to prevent the seeds from adhering to the sides. The back part of the beam to which the coverers, and rake, &c. are attached, is connected to the other part of the beam by a joint behind the sowing beam. The handles are jointed to the forward part of the beam, and also to the back part.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the construction of the hopper, as before described, and the mode of supporting it, in combination therewith; and in forming the beam with a movable joint, to allow of the coverers and rake adapting themselves to inequalities of surface, and also in the

mode of attaching the handles to the movable and fixed parts of the beam, as described."

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34. For an improved mode of *Extracting the Alkaline Properties of the Ashes of Wood in the Manufacture of Pot and Pearlashes;* Jacob Osborn, Elyrica, Lorrain county, Ohio, July 18.

The claim on which this patent was granted, is as follows. "What I claim as my invention, and desire to secure by letters patent, is the addition and application of alum with lime and salt, in such proportions as will extract the whole of the alkaline properties of the ashes, and operate as a cleanser of the article produced." If the patentee would have the goodness to omit the alum and the salt, and employ the lime alone, we will venture to assure him that he would manufacture a more pure article; but then, it is true, he would not exercise the exclusive right to adulterate the alkali in his own way.

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35. For an improvement in *Cooking Stoves;* Lester Tilden, Barre, Washington county, Vermont, July 18.

The body of this stove is made for three boiler holes, one directly over the fire, and one at each end. The back plate is made in a triple curve, so as to concentrate the heat more perfectly around the boilers in the passage of the draught to the flues; from each of these curves a flue runs back to conduct the draught to three vertical pipes which communicate with the flue around the elevated oven, from whence it is taken by a pipe into the chimney. The vertical pipes are each provided with a damper, so that by closing, and opening them, or some of them, the heat can be divided, or concentrated, at pleasure.

Claim.—"Having thus fully described the manner in which I construct my cooking stove, what I claim therein as constituting my invention, and desire to secure by letters patent, is the triple curved form given to the back plate thereof, for the purpose of concentrating the heat upon the boilers, in combination with the elevated oven, and with the separate flues leading from the three compartments of the body of the stove to the three pipes which connect them with the oven flues."

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36. For a *Platform Balance;* Albert Dole, Bangor, Maine, July 18.

The levers in this balance are so arranged that instead of being suspended from the steelyard, and the weight on the balance pulling down, it pushes up, and the bearing is between the fulcrum and the weight; this is effected by having the platform rest on bearings, on the levers, outside the fulcra. Claim.—"What I claim as my invention and improvement, and which I desire to secure by letters patent, is constructing the levers with bearing points beyond their centres, or fulcrums, (fulcra,) for the feet of the platform to rest upon, and placing upon the end of the long lever a vertical rod, extending to the beam above, and upon which it rests, the whole as described."

What is the benefit derived from simply reversing the action of a part of the balance, in the manner described, is not very apparent, and the patentee has not pointed it out.

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37. For *Lottery Schemes;* Joseph Vannini, City of New York, July 18.

Whether lottery schemes belong truly to the class of *useful inventions*, may admit of doubt. That before us is somewhat intricate, is not very clearly set forth, and we should gratify but few of our readers by an attempt to analyze and display it; on our own part we should consider the time very unprofitably occupied, and shall, therefore, think that we have done enough in giving the claim.

"What I claim as my invention, and desire to secure by letters patent, is the mode herein described, of forming lottery schemes by making tickets with a series of ternary and binary combinations, with extra numbers on each ticket, and diminishing the number of tickets in every lottery, and regulating the drawing, in the manner set forth."

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38. For an improved *Mill Bush;* Jacob Aulabaugh, East Berlin, Adams county, Pennsylvania, July 18.

Several patents have been granted for mill bushes, very similar to that before us; the bush is made in sections, and is forced, and kept tight, against the spindle, by means of weighted wedges. The casing which contains the bush and wedges, is filled with oil, to lubricate the spindle; and the oil is prevented from running out of the holes, through which the rods pass that form the connexion between the weights and the wedges, in the following manner, viz. A shoulder, or flanch, projects from the upper back edge of each wedge, to which a rod is attached that passes through a hole made in a "stem," on which the back of the wedge slides; it being grooved out for that purpose. The lower end of each rod is attached to a weighted lever.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of preventing the escape of the oil at the apertures through which passes the connexion between the weight and wedge, by the combination of the rod attached to the weight, the hollow stem, and the opening in the wedge into which the hollow stem fits, as herein described."

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39. For an improvement in *Hydrants and Fire Plugs;* S. H. Davis, Cincinnati, Ohio, July 18.

The valve seat of this hydrant is attached to the lower end of a copper tube, through which the water is to be discharged, and its lower end screws on to the street pipe. The valve is attached to the lower end of a rod, and is closed by being drawn up against its seat. The valve rod passes through the upper end of the copper tube, and is surrounded by a spiral spring, which acts against a shoulder at the upper end of the rod and the top of the tube, and the tension of the spring keeps the valve closed. Above the valve seat there is a ring

attached to the sides of the chamber by means of arms, allowing the water to pass between the outside of the ring and the inside of the tube—the valve rod passing through its centre. The valve rod is provided with a collar faced with leather on the under side, a little above this ring, and the ring has a hole made in its upper surface, which passes through one of its arms, and through the tube. When the valve rod is pressed down, the leather on the collar closes the hole in the ring, and opens the valve, which allows the water to flow up, and out of the pipe, but when it is liberated, the tension of the spring closes the valve, which stops the flow of water, and opens the hole in the ring, through which the water in the tube is discharged, to prevent freezing.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is placing the valve seats in a separate chamber, which is adapted to, and made to screw on a chamber connected with, and opening into the main pipes, and fitting to the valve seats in said chamber, valves placed on a vertical stem passing through a tube connected with the upper part of the chamber, said stem being operated by springs, in the manner, and for the purpose herein set forth."

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40. For an improvement in the *Spindle and Trundle Head of Mills;* Eldridge G. Potter, Lebanon, St. Clair county, Illinois, July 18.

The proposed improvement is for forming the connexion between a trundle head and its spindle, to prevent the "backlash." Instead of having the trundle head fixed to, it turns freely on the spindle, and is provided with arms, that act against springs attached to the spindle, and by this connexion the spindle is put in motion. The claim is confined to this device.

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41. For an improvement in the *Thumb Latch;* Philos, Eli W., and John A. Blake, New Haven, Connecticut, July 21.

This patent was granted for some modifications of the thumb latch, which, although but slight, will be important to the manufacturer. As the claims could not be understood without a full description of the modifications, which would require drawings to illustrate them, they are omitted. The improvements consist of a peculiar manner of arranging the thumb lever, so as to dispense with the fulcrum pin, and in the formation of some of the other parts of the latch, by which they can be cast more perfectly, and with greater facility than heretofore.

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42. For *Machinery to be Employed in Turning Various Articles;* John Clark, Jr., Glasgow, North Britain, July 30.

A number of mandrels are ranged around a circle, with their axes parallel to each other; to each of them a rotary motion on their own axes is communicated, and they, at the same time, are made to travel around the centre of the circle, around which they are ranged. The articles to be turned, or shaped, are properly attached to these man-

drels, and as they travel round they come in contact with rotary, or permanent, cutters, rasps, &c., properly arranged within and without the circle; or the mandrels may be ranged in a straight line, and whilst they have a rapid rotary motion on their own axis, they, at the same time, traverse in a straight line, and are thus brought in contact with a series of rotary cutters, &c. &c., arranged in a straight line. The claim is to "the combination of machinery, whereby a number of articles to be turned are arranged parallel to one another, in a circle, or straight line, and made to pass by a series of rotary, or stationary, cutters, grinders, &c.

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43. For a *Smut Machine;* Hiram Smith, Bethany, Genessee county, New York, July 31.

This machine consists of a vertical cylinder with beaters thereon, ranged around in sets. These beaters revolve in a cylindrical casing, which is provided with ledges, or flanches, running around in the direction of the diameter, one between each set of beaters; the casing is furnished towards its upper and lower ends with vertical apertures similar to those of venetian blinds. The inner surface of the casing and the ledges are rough. The grain is fed in at the top, and discharged at the bottom. Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the mode of constructing the cylinder by forming it with circular ledges and oblique apertures, in combination with the revolving beaters, constructed, and operating in the manner set forth."

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44. For improvements in the *Mariner's and Surveyor's Compass;* William C. Poole, Lancaster, Pennsylvania, July 31.

The patentee says—"The nature of my invention consists in a fixture, to be attached to either a surveyor's, or mariner's, compass, by means of which the absolute variation may be ascertained by the meridian sun. This fixture is provided with reflectors, one movable, placed at right angles with the sights of the compass, and the other, stationary, attached to one of the sight vanes, in which an observer may, by the action of the moving reflector, see the sun at meridian."

"What I claim as my invention and discovery, and desire to secure by letters patent, is the method herein described of obtaining the meridian line, and thereby ascertaining the variation of the needle, by means of a compass constructed with a fixed and movable reflector."

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45. For a *Balance, or Scale Beam;* Seth E. Winslow, Philadelphia, Pennsylvania, July 31.

A peculiar manner of making the fulcra of a scale beam is the subject of this patent. Instead of having the fulcra, on which the beam rests, separate from those of the shackle, to which the articles to be weighed are suspended, the two sets are made of one piece of metal, and may be brought very near together. A piece of metal of the requisite size for the axis of the beam is taken, and its lower side is

reduced to an edge; this edge is then rolled, or turned up, at an angle of 180°. A portion is then cut away from each of the ends, which are formed so as to constitute the usual knife edge bearings, or fulcra. The shackles are made with holes of sufficient size, and of the necessary form, to pass over the body of the axle on each side of the beam, and rest upon the turned up edge, and that part of each end which is formed in the usual way, projects beyond the shackle, and rests in the holes of the suspending shackle. The claim is confined to the "construction of the single axle with double fulcra, as described."

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46. For *Making, Ruling, and Cutting Paper;* John Ames, Springfield, Massachusetts, July 31.

In this machine the ruling machine is combined with the cutting and drying part of a paper making machine, in such manner that as the paper leaves the drying cylinder it is conducted to a roller with a set of pens, which rules it on one side, and thence to another, which rules it on the opposite side, whence it passes to the machine, which cuts it into sheets. The second ruling machine has a cam, which lifts the pen at certain regulated distances, for the purpose of ruling letter paper, which is ruled on three sides only. Claim.—"What I claim is the combining of the ruling and cutting machines with the drying cylinder, from which drying cylinder the paper is delivered in an endless sheet; said combination being made substantially in the manner herein set forth; the paper, when required, being successively ruled on both sides, by means of two ruling cylinders and their appendages, in the manner described, and being conducted from the last cylinder to the cutting machine, also as described.

I likewise claim, in combination with the ruling and cutting apparatus, the manner of raising the pens on the second ruling cylinder, by means of the cam and its appurtenances, so as to leave the required portion of the paper unruled."

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47. For improvements in *Portable Baths;* J. Wright Warren, Jr., Boston, Massachusetts, July 31.

The patentee says—"The object of my invention is to combine in one arrangement all the conveniences for taking all the several descriptions of baths, such as warm, cold, vapour, medicated vapour, and shower baths, said arrangement being constructed with due regard to simplicity and portability."

The apparatus is arranged like a couch, the box for containing the water being provided with a hinged cover. This cover is pierced with holes, for taking the vapour baths. The apparatus for generating the vapour, whether medicated or not, is separate from the other parts, the vapour being admitted through suitable pipes. The apparatus for the shower bath is suspended from the upper part of the machine; it would be useless to give the claims, as they refer throughout, to the drawings.

Specifications of American Patents.

Specification of a Patent for an Improvement in the Process of Manufacturing Fair Leather. Granted to John L. Turner, *of Philadelphia, Pennsylvania, July 15th,* 1840.

To all whom it may concern: Be it known that I, John L. Turner, of the City of Philadelphia, State of Pennsylvania, have invented, or discovered, an improvement in the process for manufacturing that kind of leather which is technically denominated *fair leather*, and which is used by saddlers, coach makers, book binders, and others, for various purposes in the useful arts; and I do hereby declare that the following is a full and exact description of my said improved process, for the purpose of giving to fair leather that light appearance, and that particular colour, which is required in its various applications. I take it in that part of the process of manufacturing it subsequent to its having been thoroughly scoured, set out, and stuffed, preparatory to the process of drying, and in this state I take sulphuric ether, and with a brush, or other suitable article, I wash, or spread over, this fluid, on the face of the leather which is to be whitened. Before performing this operation, I prepare a mixture of tallow and spirits of turpentine, incorporated in such proportion as to have the consistence of thick oil; and with this I immediately, in like manner, pay over, or cover, the surface of the leather, which is then ready to be dried in the usual manner.

By the action of the sulphuric ether, the required whiteness, or fair appearance, is given to the leather, but if it is dried after the application of the ether, without that of the tallow and spirits of turpentine, or of some analogous softening material, there will be a degree of harshness, and want of pliability, produced upon the surface, which is objectionable, and which, by the means prescribed, is entirely removed. Having thus fully described the nature of my improvement in the process of manufacturing what is known under the denomination of fair leather, and shown the manner in which I carry the same into effect, what I claim therein as constituting my invention, or discovery, is the employment of sulphuric ether, to produce the required light, or fair appearance, in such leather, in the manner, and under the conditions, substantially as herein set forth.

It is highly probable that some other of the etherial fluids, such, for example, as nitric, or muriatic ether, would produce an effect similar to that produced by sulphuric ether, but as the latter is perfectly effectual in its operation, and can be most economically obtained, I have not thought it necessary to essay the other kinds, but I do hereby declare that I do not intend to limit my claim to the use of sulphuric ether alone, but that I embrace therein, and intend to use, any of the fluids properly denominated ether.

John L. Turner.

Remarks by the Editor.—We give the foregoing specification not

because we think the *invention* one of great importance. When this patent was issued we were entirely at a fault in endeavouring to discover the rationale of the process; and we have been subsequently informed by a respectable and intelligent manufacturer, who has essayed it, that the intended effect is not produced by the means set forth. If this is the fact, and the patentee has not told "the whole truth," he has not fulfilled the requirements of the law, and his patent is a nullity.

Specifications of English Patents.

Specifiation of a Patent Granted to Gerard Ralston, *of the City of London, for Improvements in Rolling Puddle Balls, or other masses of Iron,—being a Communication.* [Sealed 22nd of February, 1840.]

These improvements in rolling paddle balls, or other masses of iron, consist in the employment of a peculiar construction of machine, for the purpose of compressing, and rolling out, red hot balls, or masses of puddle iron, into that state commonly called bloom, preparatory to the mass being rolled down into bars, or plates, or operated upon by tilt hammers.

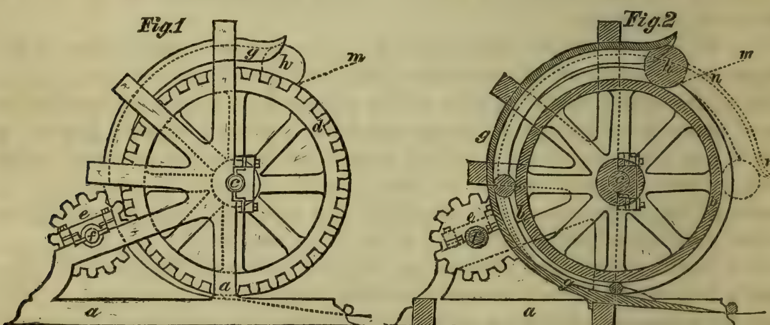

Figure 1 represents a side elevation of the machine; and fig. 2 is a section taken vertically through the rolling cylinder. *a, a, a,* is the framework supporting the machinery, which framework may be of cast iron, or any other suitable material. *b, b,* is the rolling cylinder, turning upon an axle *c, c,* supported by the side frames; and *d, d,* are toothed wheels, affixed to the ends of the cylinder. *e,* is one of two pinions, or small wheels, upon a shaft *f,* also mounted upon the framework; which pinions, or wheels, being driven by any convenient power, and taking into the teeth of the wheels *d, d,* cause the cylinder *b,* to revolve.

A segmental piece of iron, *g, g,* is firmly fixed to the framework,

partially embracing the cylinder *b, b*; but in an eccentric position to the periphery of the cylinder, as shown in the section, fig. 2. Between this segment piece, and the cylinder, the ball, or mass of red hot puddle iron *h,* is passed, for the purpose of rolling and compressing it.

The large ball, or mass of iron, having been prepared in the puddling furnace in the ordinary way, it is to be introduced into the machine, as shown at *h*. Rotary motion being given to the cylinder as described, the mass of iron will be carried forward between the cylinder *b*, and the segment piece *g*, by which it will be gradually compressed and reduced in its diameter, increasing in length until it is ultimately delivered out at bottom in the form of a roll, or long cylindrical piece, ready to be taken to the tilt hammers to be drawn out, or to the ordinary rollers, where it may be rolled into a bar, or sheet.

It may be here remarked, that the mouth of the segment piece *g*, should be made nearly simicircular, which form it partially retains for the purpose of compressing the mass on all sides during one or two rotations of the ball; but that its groove thence gradually widens out towards the end; which form is for the purpose of confining, or upsetting the ends of the mass of iron under operation.

The patentee claims, first:—The entire machine, as above arranged, for rolling, or shaping, puddle balls, or other masses of iron, preparatory to being rolled, or even drawn into a bar by the hammer; but he states, the outside casing might be brought farther down in front of the machine, as represented by the dotted line *n, n*, fig. 2; which arrangement improves its operation, giving a greater number of revolutions to the ball,—consequently reducing it more gradually.

Secondly:—He claims the plan of laying the above named machine in a horizontal position, when found better adapted to the situation where it is placed, and so altering it as to permit the upper flanch, or edge, of the segment piece, to rise and fall, to admit of a larger or smaller ball. The weight of the said flanch being so proportioned as to upset the ends of the ball, or bloom, sufficiently.

The same effect may be also produced by a cylinder, revolving within a stationary curved casing, as above described; or by a straight plate of iron, held stationary, in lieu of the above-described casing; while another, shaped like a wedge, is confined at a suitable distance apart, and moved by a crank; thus rolling a ball into a bloom each revolution of the said crank, the principle being one and the same.

Lond. Jour. Arts and Sciences.

Specification of a Patent Granted to Pierre Armand Le Comite de Fontainemoreau, *of Skinner's Place, Sizelane, for Certain Improvements in Covering and Coating Metals and Alloys of Metals. February* 15*th*, 1841.

These improvements relate to an improved mode of covering or coating certain metals or alloys of metals, with gold, silver, or platinum.

Firstly, of gold; this process is particularly applicable to coating or covering copper and its alloys, to silver and its alloys, and to some other alloys more or less alloyed with copper; to iron, tin, bismuth, antimony, and to the several alloys of these metals.

In all cases, the first operation consists in preparing or cleansing the article to be coated, or covered, after the workman has given it the precise form which it is to retain; for this purpose it is heated to redness, and when moderately cooled, it is to be quenched in water slightly acidulated with sulphuric acid. A bath is prepared by adding one part (by weight,) of sulphuric acid to one part of water and two parts of azotic acid, into which the goods are to be placed. When the articles begin to turn black, they are to be taken out of this bath, and thrown into azotic acid of thirty to thirty-six degrees of Beaume's areometer, when they will become of a fine bright yellow colour, and are to be washed in fair water and scratch-brushed. The work is then to be burnished in such parts as are to be finished in that way. Silver articles are to be cleaned by heating them, and then throwing them into acidulated water, and letting them remain for three or four hours, or until they become white, when they are to be taken out and scoured with water and fine sand.

A solution of gold is prepared by dissolving pure gold in a finely divided state in brome or chlorine, or in some azote chlorohydric acid, or in some azote iodydric acid; this solution is evaporated to the consistence of sirop.

The operation may then be conducted by any one of the following five methods, which constitute five different modes of gilding, the first being preferred.

First Bath.—Four hundred parts (by weight,) of distilled water are to be placed in an enamelled iron pot, and made tepid, when seventy parts hydrated oxide of barium, hydrate of barytes, or seventy parts hydrated oxide of strontium, hydrate strontites, are added. When these are dissolved, the gold solution is added, and the whole boiled together; as soon as the mixture begins to turn purple, the articles of copper, or its alloys, are to be immersed therein. On being taken out they are first dipped in acidulated water, afterwards in fair water, scratch-brushed, and dried off in sawdust. If silver articles are to be gilded, they must be covered with copper wire, otherwise they will not take the gold.

Second Bath.—Common water is to be used instead of the distilled water, with forty-five parts, by weight, of oxide of lithin, to which the solution of gold is to be added, and the operation conducted as before.

Third Bath.—Three parts of gold prepared as before, 1,000 parts water, 125 parts quicklime, or seventy-five parts of magnesia, besides twenty-five parts chlorine of calcium, or chlorine of magnesia, are boiled together, and used as before.

Fourth Bath.—Eight parts of gold in solution, fifty to eighty parts of oxide of zinc, 100 parts of water, and 350 parts chlorine of zinc, boiled, &c., as before.

Fifth Bath.—Five parts of gold precipitated by oxide of zinc, 500

parts distilled water, 250 parts chlorine of barium, or strontium, zinc, lime, or magnesia, boiled, &c. as before.

Secondly, for coating, or covering, articles with silver. Ten parts of silver are dissolved in azotic acid, evaporated to dryness, and then re-dissolved in distilled water. Into an enameled iron pot put 5000 parts of water, 900 parts of chloride of barium, or of strontium, of lime, magnesia, or zinc; to these add from 1000 to 1400 parts of cream of tartar, and boil the mixture; then add the silver solution, with twenty-five parts boric acid. The articles to be silvered are to be plunged in, and when the coating is strong enough, taken out, washed in tepid water, scratch-brushed and dried.

Thirdly, for coating and covering metals with platinum, a solution of two parts of platinum in azotic acid, chlorohydric, or boric acids; when evaporated nearly to dryness add forty parts of distilled water, fifteen parts chloride of barium, or of strontium, lime, magnesia, or zinc, or chloride of ammonia, and boil them together. The articles are to be immersed till they take a grey coat, they are then to be thrown into water, well washed, scratch-brushed, and dried.

The claim is, 1. The use of the substances named in the first mentioned process, for coating and covering metals and alloys with gold, as well as all the salts of their bases, either alone or combined with other substances; the substances being barytes, strontites, lithin, lime, magnesia, and their salts.

2. In the process for coating and covering with silver, the chlorines of barium, barytes of sodium, of strontium, strontites of lime, of magnesia, and of zinc, either alone, or mixed with other substances; and the mode of operating with them.

3. In the process of coating and covering with platinum, the use of double chlorines of platinum and of barium, barytes of strontium, strontites of magnesia, lime, ammonia, and zinc, alone, or combined. Also the oxides and salts of these bases, either alone or combined with the salts, or oxides, of platinum. Mech. Mag.

Specification of a Patent granted to Joseph Leese, Jr., *of Manchester, for Certain Improvements in Printing Calicoes and other Surfaces. December* 24, 1840.

The first of these improvements refers to the employment of a peculiarly formed fabric instead of the blanket usually employed in calico printing. This is composed of several layers of calico or other suitable fabrics, coated and cemented together with a solution of India rubber; the ends being joined, an improved endless fabric is formed, having the necessary elasticity in its thickness, but non-elastic in its length and breadth.

The second improvement relates to what is technically called "rainbowing," which is performed in the following manner; a number of sieves containing the different shades of colour are placed nearly under each other; over each sieve a disk revolves, having projections of copper wire, or other suitable material, which dip into the colours. These

disks are supported on pedestals which admit of easy adjustment, and are so regulated, that as they revolve, the projecting wires give colour to the cylinder in successively lighter shades, which are imprinted on the fabric under operation.

A third improvement relates to printing blocks, which are to be covered with a surface of India rubber, through which the pattern is to be cut, its sides being supported by a thin metal edging. This arrangement will, it is said, greatly increase the durability of the block, while the pattern will be much better printed on the calico, &c.

Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, OCTOBER, 1841.
COMPUTED BY JOHN DOWNES.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.
☞For direct vision add 180°.☜

Day.	H'r.	Min.		Star's name.	Mag.	From Moon's North point.	From Moon's Vertex.
1	7	35	Im.	101 Piscium,	6	157°	104°
1	8	24	Em.			264	212
6	15	47	Im.	ε Geminorum,	6	44	253
6	16	32	Em.			321	298
31	16	28	Im.	χ Tauri,	6	102	159
31	17	39	Em.			261	319

Meteorological Observations for July, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	72	88	29.85	29.80	W.	Moderate.		Partially cloudy—clear.
	2	72	81	.80	.85	W.	do.		Cloudy—clear.
☺	3	60	77	.90	.90	E.	do.		Clear—do.
	4	56	79	.92	.92	N.	do.		Clear—do
	5	61	84	.86	.80	W.	Brisk.	.34	Partially cloudy—clear—rain.
	6	64	82	.75	.75	W.	Moderate.		Cloudy—clear.
	7	70	79	.75	.80	W.	do.		Lightly cloudy—do.—do.
	8	62	80	.80	.90	W.	do.	.30	Cloudy—clear.
	9	62	80	.96	.95	W.	do.		Clear—clear.
	10	69	80	.79	.79	NW.	do.		Cloudy—clear.
☽	11	60	75	.87	.84	NW.	do.		Clear—clear.
	12	59	77	.80	.78	W.	do.		Flying clouds—clear.
	13	64	81	.76	.76	W.	do.		Lightly cloudy—do.—do.
	14	70	85	.76	.77	W.	Brisk.	.35	Cloudy—clear—rain.
	15	70	85	.77	.77	W.	Moderate.		Partially cloudy—do.—do.
	16	70	80	.77	.77	E W.	do.		Clear—do.
	17	62	78	.93	.94	W.	Brisk.		Clear—do.
⊗	18	62	83	.94	.94	S. SW.	Moderate.		Clear—do.
	19	62	84	.93	.96	S. SW.	do.		Clear—do.
	20	66	87	30.07	30.08	SW.	do.		Clear—do.
	21	61	85	.23	.08	SE.	do.		Clear—lightly cloudy.
	22	70	84	.12	.05	SW.	do.		Cloudy—partially cloudy.
	23	70	88	29 96	29.96	SW.	do.		Clear—clear.
	24	72	90	.93	94	SW.	do.	.17	Clear—lightly cloudy.
☾	25	76	94	.89	.82	W. SW.	Calm.		Cloudy-par. cloudy-rain in night.
	26	70	79	.83	.91	NW.	Brisk.		Clear—clear.
	27	60	79	.99	.66	NE.	Moderate.		Clear—cloudy.
	28	68	82	.98	.85	NE.	do.		Lightly cloudy—do.—do.
	29	59	77	30.00	30.00	NE.	do.		Clear—do.
	30	64	73	29.90	29.90	NE.	do.		Partially cloudy—cloudy.
	31	66	65	.70	.70	E.	do.	1.75	Rain—do.
	Mean	65.45	81.48	29.89	29.87			2 91	

	Thermometer.		Barometer.	
Maximum height during the month,	94 00	on the 25th.	30.23	on the 21st.
Minimum " "	56.00	" 4th.	29.66	" 27th.
Mean	73.47		29.88	

	Co	Maximum.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1		30.	3⅓	.	2⅓	⅔	7⅓	⅔	.	.	....	.	......	....	.	1423
2																
3		30.	6	1	1	2⅓	2⅔	.	.	1⅓	....	.	.....	....	.	1498
4																
5																
6		29.	2⅔	.	3⅓	.	2⅓	.	.	9⅔	....	.	.....	....	.	1424
7																
8																
9		28.	2⅓	.	8	⅓	6	.	.	.	....	.	......	....	.	1433
10																
11		29.	⅓	1⅓	3⅓	.	5⅓	1⅓	7	2⅓	....	.	.....	....	.	1422
12		30.	1	.	4	.	14	.	1⅓	.	....	.	......	....	.	1439
13		29.	⅓	⅔	2⅓	3	4⅔	.	1⅓	7⅓	....	.	.....	....	.	1416
14		29.	3⅓	1	.	1⅔	5⅔	.	.	10	35.32	.	.....	....	.	1429
15		29.	1⅓	1	5⅓	2	1⅓	.	.	.	30.96	.	......	41.85	.	1469
16																
17	]															
18	I	30.	⅔	.	2	.	17⅔	.	.	1	....	.	......	....	.	1415
19	I	29.	1	.	6	⅔	2⅓	.	1	.	....	.	.....	....	.	1446
20	(															
21	I															
22	T															
23	I															
24	U															
25	N															
26	J	29	3⅓	.	1⅓	.	4⅓	.	11⅓	1⅔	....	.	.....	....	.	1419
27	F															
28	C															
29	A	29	4⅔	.	4⅓	⅓	1⅔	.	4⅓	.	28.25	2⅔	.....	40.96	1⅓	1472
30	F															
31	H	29	.	.	19⅔	.	.	.	.	⅓	....	.	.....	....	.	1421
32	C															
33	P															
34	M		1⅔	.	10	.	5⅔	.	.	.	....	.	.....	....	.	1434
35	C															
36	C	28	6⅔	.	7⅓	⅓	3	.	4⅔	⅓	....	.	.....	....	.	1427
37	B	29	4⅓	6	1⅓	8	3⅔	.	.	.	....	.	... .	....	.	1420
38	S	28	2	⅔	7⅔	⅓	⅔	.	10	3	....	.	......	....	.	1459
39	In	28	6⅓	.	4⅓	.	6⅔	.	8⅓	1	....	.	...	....	.	1436
40	Je															
41	W	28	4⅓	.	4⅔	.	5	.	6	.	....	.	......	....	.	1426
42	V	29	2⅓	.	.	.	11⅔	.	.	5	....	.	.....	....	.	1432
43	Ar															
44	W															
45	F	29	13	.	2⅔	.	4⅔	.	4⅔	.	....	.	.....	....	.	1444
46	Gr															
47	W															
48	Al	29	2	.	1⅔	.	9⅔	.	6⅓	2⅓	....	.	......	....	.	1431
49	Be															
50	Bu	29	8⅔	.	7⅔	.	⅓	.	.	.	....	.	......	....	.	1421
51	Me															
52	Cr	29	1	.	⅔	.	4⅓	.	6	10⅔	....	.	......	....	.	1464
53	Er															

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

MARCH, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.
1 Philadelphia,	Philadelphia,	G. P. Schively,	37.16	48.94	41.55	71.50	19.50	42.55	.	19.00	31.81	.
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	34.22	45.45	36.35	74.00	20.00	38.67	⅔	17.50	29.31	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,										
6 Monroe	Stroudsburg,	A. M. Stokes,	28.23	48.42	37.50	72.00	15.00	38.05	15⅓	....	....	.
7 Pike,	Milford,	Ralph Bull,										
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,	31.29	42.26	36.00	69.00	10.00	36.52	.	10.00	27.75	.
10 Luzerne,	Wilkesbarre,	W. F. Dennis,										
11 Schuylkill,	Port Carbon	P. C. Lyceum,	30.39	47.70	33.65	81.00	15.00	37.25	2	15.00	26.00	1
12 Berks,	Reading,	C. F. Egelmann,	33.74	43.39	36.81	73.00	18.00	37.98	.	14.00	29.29	.
13 Chester,	West Chester,	Wm. W. Jefferis,	33.26	44.01	37.24	67.50	20.00	38.17	6⅔	17.50	30.04	6
14 Delaware,	Haverford,	Haverford School,	35.87	44.73	40.52	68.00	20.00	40.37	1⅓	16.00	30.77	.
15 Lancaster,	Lancaster,	Conservatory of Arts,	35.10	49.16	38.63	73.50	18.50	40.96	.	18.50	32.02	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	36.03	43.42	41.25	66.00	23.00	40.23	1	20.00	32.23	1
19 Northumberland,	Northumberland,	Andrew C. Huston,	32.11	43.90	36.06	70.00	15.00	37.36	.	11.00	25.41	.
20 Columbia,	Danville,	C. H. Frick.										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Kinkead,	30.02	46.50	34.84	82.00	10.00	37.12	1⅔	....	....	.
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,										
29 Adams,	Gettysburg,	Prof. M. Jacobs,	33.01	46.72	37.59	75.50	14.00	39.11	.	13.00	30.50	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	29.97	47.77	34.77	78.00	7.00	37.50	⅓	....	....	.
32 Centre,	Bellefonte,	John Harris,										
33 Potter,												
34 M'Kean,	Smithport,	M. R. Atkins,	22.35	37.94	28.55	64.00	—6.00	29.61	.	....	....	.
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	26.45	40.83	30.13	73.00	00.00	32.47	⅓	00.00	25.29	.
37 Bedford,	Bedford,	Samuel Brown,	33.38	48.32	37.05	77.50	11.00	39.58	.	....	....	.
38 Somerset,	Somerset,	George Mowry,	28.41	41.11	33.39	70.00	1.00	34.30	3	1.00	25.41	3
39 Indiana,	Indiana,	Richard White,	35.23	42.47	31.69	76.00	12.00	36.46	1⅓	....	....	.
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	J. E. King,	29.35	42.93	33.13	70.00	00.00	35.14	.	....	....	.
42 Venango,	Franklin,	Wm. Connely,	23.32	46.43	31.84	76.00	—13.00	33.86	⅓	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weethee,	32.68	46.35	34.92	82.00	—1.00	37.98	.	....	....	.
46 Green,												
47 Washington,	Cannonsburg,	Prof. A. H. Campbell,										
48 Alleghany,	Pittsburgh,	J. P. Bakewell,	36.33	46.93	....	80.00	10.00	41.63	11	....	....	.
49 Beaver,	Beaver,	James Allison,										
50 Butler,	Butler,	Jacob Mechling,	31.32	44.29	39.16	76.00	—2.00	38.26	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	David Dick,	25.09	46.35	33.13	76.00	—17.00	34.86	8	—18.00	20.09	8
53 Erie,	Erie,	Park & Reid,										

County.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	30.04	30.03	30.04	30.44	29.35	30.04	.	15⅔	15⅓	.	....	....	....	..	......
3 Bucks,	29.99	29.98	29.97	30.47	29.26	29.98	⅔	10⅔	19	1⅓	3	6	....	..	4.952
6 Monroe	29.25	29.26	29.19	29.75	28.03	29.23	14	5	11	15	2	7	. ..	..	......
9 Susquehanna,	28.05	28.06	28.06	28.36	27.77	28.06	.	13	18	.	4	2	....	..	1.755
11 Schuylkill,	29.29	29.28	29.27	29.90	28.62	29.28	2	10⅓	18⅓	2	3	6	3	1	3.376
12 Berks,	29.82	29.75	29.83	30.38	29.25	29.80	.	9⅔	21⅓	.	2	4	3	1	......
13 Chester,	29.47	29.47	29.46	29.87	28.80	29.47	6⅔	.	.	.	2	5	4	..	......
14 Delaware,	29.52	29.45	29.49	29.87	28.98	29.49	.	7	24	.	11	....	....	..	4.031
15 Lancaster,	29.44	29.41	29.41	29.84	28.98	29.42	.	13⅓	17⅔	.	3	4	5	..	4.057
18 Dauphin,	29.75	29.71	29.71	30.16	29.05	29.72	1	.	.	.	2	5	1	..	3.820
19 Northumberland,	29.41	29.38	29.39	29.81	28.72	29.39	.	8	23	.	3	9	3	1	3.774
26 Juniata,	29.47	29.41	29.41	29.87	28.27	29.43	1⅔	8⅔	20⅔	1⅔	2	6	1	1	......
29 Adams,	29.33	29.30	29.33	29.68	28.60	29.32	.	12⅔	18⅓	.	6	2	2	..	5.367
31 Huntingdon,	29.29	29.25	29.27	29.67	28.68	29.27	⅓	13	18	.	2	6	1	..	2.705
34 M'Kean,	....	....	....	....	....	....	.	13⅓	17⅔	.	2	12	....	..	.. ...
36 Cambria,	27.77	27.75	27.78	28.15	27.24	27.77	⅓	8	22⅔	⅓	1	10	....	..	......
37 Bedford,	29.19	29.15	29.15	29.52	28.55	29.16	.	13	18	.	2	5	....	..	......
38 Somerset,	27.82	27.83	27.81	28.50	27.29	27.82	3	12	16	3	3	10	2	..	2.172
39 Indiana,	28.52	28.51	28.51	28.90	28.00	28.51	1	9⅓	20⅔	1	4	11	....	..	2.353
41 Warren,	28.61	28.60	28.60	28.96	28.05	28.60	.	6	25	.	....	....	....	..	......
42 Venango,	28.85	28.87	28.89	29.25	28.29	28.87	5	9⅔	16⅓	5	6	4	....	..	4.134
45 Fayette,	28.97	28.97	28.98	29.38	28.50	28.97	.	15	16	.	2	7	....	..	3.625
48 Alleghany,	29.15	29.13	29.16	29.63	28.30	29.15	2⅓	10⅔	18	2⅓	3	6	1	2	3.007
50 Butler,	28.67	28.72	28.71	29.10	28.20	28.70	.	16⅓	14⅔	.	5	9	....	1	4.677
52 Crawford,	28.98	28.96	28.96	29.45	28.40	28.97	8	8⅔	11⅔	10⅔	....	....	....	..	......

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.
1 Philadelphia,	1	2	6	1	⅔	⅔	1⅓	.	2	1⅔	3⅓	.	2⅓	⅔	7⅓	⅔	.	.
3 Bucks,	2⅔	⅔	6	⅓	.	.	⅓	⅓	⅓	⅓	6	1	1	2⅓	2⅔	.	.	1⅓
6 Monroe	1⅓	1	1⅔	.	7	.	⅔	.	⅔	⅔	2⅔	.	3⅓	.	2⅓	.	.	9⅔
9 Susquehanna,	6⅓	.	2	.	.	.	⅔	.	5⅓	.	2⅓	.	8	⅓	6	.	.	.
11 Schuylkill,	.	⅓	7	⅓	1	.	⅓	⅔	⅓	.	⅓	1⅓	3⅓	.	5⅓	1⅓	7	2⅓
12 Berks,	1	.	3⅔	.	2⅔	.	⅔	.	⅓	.	1	.	4	.	14	.	1⅓	.
13 Chester,	2⅔	2	2⅔	.	2⅓	⅓	⅓	.	1	.	⅓	⅔	2⅓	3	4⅔	.	1⅓	7⅓
14 Delaware,	⅔	1	4⅔	⅓	.	.	1⅔	⅓	1	.	3⅓	1	.	1⅔	5⅔	.	.	10
15 Lancaster,	4	⅓	5⅓	1	3	⅓	2	.	2⅔	1⅓	1⅓	1	5⅓	2	1⅓	.	.	.
18 Dauphin,	⅔	.	⅓	.	1⅓	.	5	.	2⅓	.	⅔	.	2	.	17⅔	.	.	1
19 Northumberland,	4⅔	⅔	4⅓	.	4⅓	.	3	⅓	2⅔	.	1	.	6	⅔	2⅓	.	1	.
26 Juniata,	.	.	4⅓	.	2	.	2⅔	.	.	.	3⅓	.	1⅓	.	4⅓	.	11⅓	1⅔
29 Adams,	5⅓	2	3⅔	⅓	1	.	⅓	.	2⅓	⅔	4⅔	.	4⅓	⅓	1⅔	.	4⅓	.
31 Huntingdon,	.	.	.	.	11	.	.	.	.	.	.	.	19⅔	.	.	.	.	⅓
34 M'Kean,	1	.	3	.	6⅓	.	3	.	⅓	.	1⅔	.	10	.	5⅔	.	.	.
36 Cambria,	⅔	.	1⅓	.	1⅔	.	4⅔	.	⅓	.	6⅔	.	7⅓	⅓	3	.	4⅔	⅓
37 Bedford,	⅓	⅔	.	⅔	.	⅔	4	⅔	.	⅔	4⅓	6	1⅓	8	3⅔	.	.	.
38 Somerset,	⅔	⅓	⅔	.	2⅔	.	⅔	⅓	⅓	1	2	⅔	7⅔	⅓	⅔	.	10	3
39 Indiana,	.	.	1	.	.	.	2	.	1⅓	.	6⅓	.	4⅓	.	6⅔	.	8⅓	1
41 Warren,	.	.	2	.	1⅔	.	6⅔	.	⅔	.	4⅓	.	4⅔	.	5	.	6	.
42 Venango,	.	.	.	.	.	.	12	.	.	.	2⅓	.	.	.	11⅔	.	.	5
45 Fayette,	1⅓	.	1	.	.	.	3	.	.	⅔	13	.	2⅔	.	4⅔	.	4⅔	.
48 Alleghany,	.	.	3	.	2	.	3⅔	.	⅓	.	2	.	1⅔	.	9⅔	.	6⅓	2⅓
50 Butler,	.	.	3⅓	⅓	10⅓	.	.	.	.	⅓	8⅔	.	7⅔	.	⅓	.	.	.
52 Crawford,	2⅓	.	.	.	⅓	.	1⅓	.	4⅓	.	1	.	⅔	.	4⅓	.	6	10⅔

County.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	....	.	.....	....	.	1423
3 Bucks,	....	.	.....	....	.	1498
6 Monroe	....	.	.....	....	.	1424
9 Susquehanna,	....	.	.....	....	.	1433
11 Schuylkill,	....	.	.....	....	.	1422
12 Berks,	....	.	.....	....	.	1439
13 Chester,	....	.	.....	....	.	1416
14 Delaware,	35.32	.	.....	....	.	1429
15 Lancaster,	30.96	.	.....	41.85	.	1469
18 Dauphin,	....	.	.....	....	.	1415
19 Northumberland,	....	.	.....	....	.	1446
26 Juniata,	....	.	.....	....	.	1419
29 Adams,	28.25	2⅔	.....	40.96	1⅓	1472
31 Huntingdon,	....	.	.....	....	.	1421
34 M'Kean,	....	.	.....	....	.	1434
36 Cambria,	....	.	.....	....	.	1427
37 Bedford,	....	.	.....	....	.	1420
38 Somerset,	....	.	.....	....	.	1459
39 Indiana,	....	.	.....	....	.	1436
41 Warren,	....	.	.....	....	.	1426
42 Venango,	....	.	.....	....	.	1432
45 Fayette,	....	.	.....	....	.	1444
48 Alleghany,	....	.	.....	....	.	1431
50 Butler,	....	.	.....	....	.	1421
52 Crawford,	....	.	.....	....	.	1464

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Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[continued from page 154.]

Terrestrial Geomorphy.—General Principles, Stations and Signals.

109. To determine the relative position of the most prominent points of an extensive district of country, such as a province or kingdom, the most elevated points are selected commanding an extensive view of the surrounding country. From these places, called *stations*, the observations are made. When necessary, sheds are constructed at them, and *signals* which can be seen from the neighboring stations. To economize time, trouble and expense, and to attain greater precision, the stations should be as far apart as possible (usually 8 or 10 thousand metres, or 5 or 6 miles.) The stations joined by imaginary lines constitute a plexus formed of a series of large triangles, covering the entire country to be surveyed. All the elements of these triangles are either measured or calculated.

The engineer measures with extreme care all the angles of these triangles, and a distance called the *base*. This base is one of the sides of some one of the series of triangles. The lengths of all the other sides are found by calculation. This plexus is called a *canevas trigonometrique.*

These various triangles are, it is true, situated in space, and form a polyhedron with triangular faces enveloping the ground. But, if a perpendicular line is let fall from each summit, it meets a point under ground on the level of the surface of the sea. This surface is considered in geodesy that of the terrestrial spheroid, because the inequalities

of the mountains compared with the immense magnitude of the globe become insignificant and may be neglected. Thus we substitute for right lined triangles determined by observation, curvelinear triangles obtained by calculation. The projection of the observed triangles on the terrestrial spheroid is called *reducing them to the horizon.* As the figure of the spheroid differs very little from that of a sphere, each of these projections is assumed to be made on a sphere of a certain radius, regard being had to the smallness of each triangle. This radius varies with the place.

The largest triangles in the plexus are called *triangles of the first order.* When they are established, other stations within them are selected, and connected with them by observations made with great care, though not with as much as the observations made for the primitive triangles. The triangles of the second order, smaller than those of the first, are thus established.

These in their turn are made use of to form the *triangles of the third order.* When their sides do not exceed six hundred or a thousand metres (656 or 1095 yards) in length, the curvature is so little appreciable that they may be regarded as right lines. These lengths serve to determine positions in detail, and complete the topography. Thus geomorphy embraces the exact determination of the triangles of the first, second and third orders, and their projection upon the terrestrial spheroid.

110. It is also proposed to show under this head the manner of finding the length of an arc of the meridian traversing a plexus. It is evident that this length cannot be measured satisfactorily. The operation of measuring a base of 6 or 7 miles, on even ground is extremely difficult, how much more so then would it become to measure a large terrestrial arc traversing hills, mountains, and other obstacles. It can only be attained by calculating the arc in parts as will be explained.

The terrestrial meridian which traverses France, from Dunkirk to Barcelona was obtained in this manner; the arc has since been produced beyond these limits. Arcs perpendicular to this meridian have also been determined. By these operations, the figure and dimensions of the terrestrial spheroid, the length of the metre, &c., have been ascertained.

The *longitude* and *latitude* of each station, and the *azimuth* of each side of the triangle is also necessary to be known. Astronomical observations furnish these elements for some of these stations, and calculation gives them for others.

The elevation of each station above the surrounding ground, and

above the terrestrial spheroid is called the *altitude*, and is ascertained by leveling.

These are the subjects it is proposed to treat in geomorphy.

111. We will now examine the best manner of placing the stations with regard to each other to insure correct results.

Let a b c (fig. 32 see plate II., vol. 1,) be the sides of any triangle, and A B C the angles respectively opposite to them,

we have $a \sin. B = b \sin. A$. . . . . (1)

This equation gives the side a when we know A, B, and b. Now if any little error has been committed in the measurement of these angles, for example an error at A equal to y, and one at B equal to y', b being supposed correct, instead of using the values A and B, we use the erroneous ones $A + y$ and $B + y'$. This will make an error in the value of x expressed by b; and equat. (1) becomes

$$(a + x) \sin. (B + y') = b \sin. (A + y).$$

Develope these sines, and as y and y' are always very small, substitute their arcs for their sines, and 1 for their cosines; it will then become

$$(a + x)\ (\sin. B + y)\ \cos. B) = b\ (\sin. A + y \cos. A).$$

Reduce this by the aid of equation (1) and suppress the product $x\,y' \cos. B$, and we have

$$x \sin. B + a\,y' \cos. B = b\,y \cos. A,$$

and by placing $\dfrac{a \sin. B}{\sin. A}$ for b, we have

$$x = a\ (y \cos. A - y' \cos. B).$$

This then is the error in the sine a produced by the errors of observation y and y' at the angles A and B.

It is evident that x is small in proportion as A and B approach equality, supposing y and y' equal; and the error is nothing when y and y' are equal and of the same algebraic sign and $A = B$. In this case the side a is given correctly by calculation, although erroneous observations have been used. If the errors y and y' are equal and of contrary signs, the equation becomes $x = a\,y\ (\cos. A + \cos. B)$, which the condition $A = B$ makes a *minimum*.

We have $x = a\,y \left(\dfrac{\cos. A}{\sin. A} + \dfrac{\cos. B}{\sin. B}\right) = a\,y \dfrac{\sin. (A + B)}{\sin. A \sin. B}$

and by substituting $\dfrac{\cos. (A - B) + \cos. C}{2}$ for $\sin. A \sin. B$. (See trigonometry.)

we have $x = a\,y\ \dfrac{2 \sin. C}{\cos. (A - B) + \cos. C}$, an expression which has evidently the smallest possible value when $A = B$.

We see then, that for the purpose of reducing the error, it is most favourable under any circumstances that the triangle should be *equilateral. When the sides sought are each equal to the measured side*, it may be regarded as certain, *that the error of the angles is insensible.* But, as it is frequently impossible to have the triangle equilateral, we are satisfied with approaching this condition by never admitting an angle of a triangle less than 30°. We say then that *the triangle is well adapted.* The stations should be chosen to conform to this principle as nearly as possible.

112. Suppose now that the side b is not of the proper length, but that the angles A and B are correct. The true value of b will be replaced by $b + z$, and a by $a + x$; z and x being the errors;

$$\text{then } (a + x) \sin. \text{B} = (b + z) \sin \text{A},$$

$$\text{and } x \sin. \text{B} = z \sin. \text{A}; \; x = z \frac{\sin. \text{ A}}{\sin. \text{ B}}$$

Thus the smaller the angle B is, the greater will be the effect of the error z on the opposite side a. When B $= 30°$, the smallest limit allowed, we have sin. B $= \frac{1}{2}, x = 2\,z$ sin. A. But then A + C $= 150°$, and each of the angles A and B should be nearly 75°; the sin. A then differs little from 1, and x from $2\,z$. Thus the error z committed on the side b is carried to the side a and doubled. In this manner the error increases from one triangle to another until in the end it is very great.

We conclude therefore that in a triangle well adapted, a small error committed in measuring the length of one of the sides, is much more mischievous than an error made in the measurement of the angles, because in the first, under favourable circumstances, it increases, and may even become doubled in calculating the other sides, while errors from the angles do not necessarily alter the value of the sides deduced from them. It is evident then that the base must be measured with extreme precaution, or the errors will accumulate from one triangle to the other.

113. It is almost impossible to measure the base with absolute accuracy. It is very short compared to the extent of country to be plotted, and is one of the sides of the first triangle, which is connected with a second, and this last with a third, and so on, each triangle increasing a little. When they are nearly equilateral, the accumulation of error is avoided and the results may be relied on. But when the operation is finished it is necessary to test its accuracy. This is done by measuring another base, far away from the first, and forming one of the sides of a triangle. If the triangulation is exact the measured length of the side of the triangle will correspond to the length obtained by calculation.

The longitudes and latitudes of the stations and the azimuths of the sides of the triangles form another means of verifying the accuracy of the triangulation. These angular values being determined at one station by astronomical observations, we find what they are at another station by calculating the position of the intervening stations in succession. The astronomical observations are repeated at the station to be verified, and a comparison of them with the calculated position of the station indicates the errors if any, and the compensation to be made for them, without, however, invalidating operations absolutely correct.

Laplace has demonstrated, that it is better to use as few triangles of the first order as possible; and that they should be of as large dimensions as the localities and the power of the telescopes admit.

114. The *signals* should be established in such a manner as to be seen with distinctness a great distance. Vertical stakes and reversed cones are excellent for this purpose. Steeples, spires, towers, &c., should only be used when the observer can place himself at them to observe with facility and especially with stability; and care should always be taken to project the axis of the signal on the ground so as to leave no uncertainty of its position. Trees without branches, and mills, may be used for triangles of the third order, because the errors resulting from them are not propagated.

The best signal is a circular iron plate with a hole in the centre. It should be fitted to a vertical rod, around which it revolves, so as to present its face to the neighbouring stations in succession.

A small quadrangular pyramid stuck on the top of a staff is also frequently used as a signal.

It was thought that Bengal fire and reverberating parabolic reflectors would be useful for nocturnal observations, as a means of employing time in foggy weather. But it has been abandoned; the horizon is never sufficiently clear at night, and terrestrial refractions increase the causes of uncertainty.

115. A signal can be seen better when projected on the sky than on the ground or the trees. Then, being stationed at A (fig. 57) it is easy to ascertain if the signal there will be seen from B, projected against the sky without going to B. For example take the zenith distance of B and that of the mountain C directly opposite, that is the angles B A Z, C A Z; the point C falls above or below the direction A B I according as the sum of these angles is greater or less than 180°. Thus we will elevate the signal A until B A Z + C A Z is greater than 180°.

All the signals projected against the sky should be painted black, and those against the ground or the forest white.

When no building can be had, which will answer the purpose both of a signal and a shelter to the engineer, it is frequently necessary to erect a temporary observatory. It is made in the form of a quadrangular pyramid truncated near the summit. (Fig. 64). A staff S in the axis serves as a signal, and the observer places his instrument at the point C, the horizontal projection of the axis. The pyramid is made of wood, and roofed to within about six feet of the ground. A cloth stretched on the windward side completes the shelter. When the observations are completed, the pyramid is removed, and a square monument firmly planted at C, with two diagonal lines drawn on it intersecting each other in the axis of the signal.

Subsequent verifications require these stations to be revisited, and the monuments thus fixed form indisputable evidence of their locality and are easy to find.

When a signal is erected, it should be sufficiently high to be seen from the neighbouring ones. It is ascertained by experiment that it should be seen at least under an angle of 31″; and as the tang. 31″ = 0.00015, the height A B (fig. 56) of the signal being A B = A C tang. C = A C × 0.00015, we see that it is necessary that this height should be at least fifteen times the hundred thousandth of its distance from the observer. If this distance is the usual one which is about 20,000 metres (21,900 yards) the signal should be more than 3 metres (9.842 feet) high. In the French triangulation the signals were given an elevation of one seven thousandth of the distance they were to be seen.

117. It frequently happens that the signal A seen from stations B and C (fig. 65) is not a fit one to observe from. It is then necessary to place the instrument in its vicinity, for example at O, and measure the angle B O C = O, and then make the corrections to reduce it to the angle B A C = A, the angle that would have been obtained if the instrument had been stationed at A. This is called *reducing the angle to the centre of the station.* The three sides of the triangle A B C, which we call a, b, c, are supposed to be known, approximately at least.

We will first suppose the case of the triangle B A C where the point O is in the direction of the side B′ A. Draw O E parallel to A C, and make A O = m, and the angle A C O = θ = C O E. The angle B′ O C, is known, and it is required to find the angle A = $\alpha + \theta$. Then the triangle C A O gives

$$\frac{\sin. C}{m} = \frac{\sin \alpha}{AC} \text{ whence } \sin. C = \sin \theta = \frac{m \sin. \alpha}{b}$$

As m is always very small in relation to b, sin. θ is very small and

may be replaced by θ, or rather by θ sin. 1″, as θ expresses the number of seconds in the arc. Thus

$$A = \alpha + \frac{m \sin. \alpha}{b \sin. 1''}$$

Now if the triangle is A B C, where the station O is not in the direction of one of the sides of the triangle, we have

$$B' A C = \alpha + \theta = \alpha + \frac{m \sin. \alpha}{b \sin. 1''}$$

$$B' A B = \alpha' + \theta' = \alpha' + \frac{m \sin. \alpha'}{c \sin. 1''};$$

$$\text{then } A = O + \frac{m}{\sin. 1''}\left(\frac{c \sin. \alpha + b \sin. \alpha}{b\, c}\right) \quad . \quad . \quad . \quad (1)$$

In the application of this formula, it is necessary to bear in mind that when the station is so placed that either one of the angles θ, θ' falls on the other side of the line A C or A B, the angle then should be subtracted from O. Thus, the two expressions c sin. α, b sin. α' are both positive, only when the station O is within the angle p A q formed by the prolongation of the sides of the triangle. When it is situated in the angle B A C they are both negative, and when O is placed in the angle C A q, or the angle B A p, as in figure 63, they are of contrary signs.

118. This last is the most favorable position for reducing the angle, and it sometimes happens that the two terms in equation (1) destroy each other and there is no correction to make. This takes place when $c \sin. \alpha = b \sin \alpha'$ whence

$$\frac{\sin. \alpha}{\sin. \alpha'} = \frac{b}{c}; \text{ then we have } \frac{b}{c} = \frac{\sin. B}{\sin. C} = \frac{\sin. (A + C)}{\sin. C},$$

and $A = \alpha - \alpha'$; from which we find $\alpha = A + \alpha'$,

$$\frac{\sin. (A + c)}{\sin. c} = \frac{\sin. \alpha}{\sin. \alpha'} = \frac{\sin. (A + \alpha')}{\sin. \alpha'},$$

Developing this equation and making the reductions, we have

$$\frac{\sin. A \cos. C + \sin. C \cos. A}{\cos. C} = \frac{\sin. A \cos. \alpha' + \sin. \alpha' \cos. A}{\sin. \alpha'}$$

whence $\cos. C = \cos. \alpha'$.

Thus the observed angle O requires no correction to become A, whenever $C = \alpha'$ or $180° + \alpha'$. In this case the quadrilateral A B C O can be inscribed in a circle, because the angles B C A and B O A have the same measure in the circle circumscribing the triangle A B C. The station O can then be chosen so as to fulfil this condition.

119. But it is seldom this case presents itself, and in all others the angle O must be reduced by equation (1). This equation is adapted

to the use of logarithms in the following manner: The triangle A B gives

$$\frac{b}{c} = \frac{\sin. (A + C)}{\sin. C};$$

and $O = \alpha' + \alpha$ may be regarded as equal to A; thus $\alpha = A - \alpha'$. By substituting these values in equation (1) it becomes

$$A = O + \frac{m}{b \sin. 1''}\left[\sin. (A - \alpha' + \frac{\sin. (A + C) \sin. \alpha'}{\sin. C}\right]$$

Reducing this expression to the same denomination, &c., it becomes,

$$A = O + \frac{m \sin. A \sin. (C + \alpha')}{b \sin. C \sin. 1''} \quad \ldots\ldots \quad (2)$$

This expresses *in seconds* the correction to be made in the angle B O C to make it equal to B A C.

120. When the signal is in the axis of a cylinder, the centre A cannot be seen from O. It is then determined by drawing lines tangent to each side of the cylinder, and bisecting the angle. Thus we measure the angles B O l', B O l (fig. 70) and the mean between them is the angle B O $k' = \alpha$.

In getting the distance O A $= m$, if we cannot measure directly the radius A $k = r$, we measure O $k = i = m - r$, and also one of the tangents O $l = t =$ O l', we will then have

$$O l^2 = O A^2 - A l^2 \text{ or } t^2 = m^2 - r^2 = (m + r) i.$$

This equation gives $m + r = \frac{t^2}{i}$; and as $m - r = i$, by adding these equations we get $2 m = i + \frac{t^2}{i}$,

It may be proper to observe that, as the terms containing α and m express very small quantities, it is not necessary to have their values very exactly; moreover, as the use of the above problem does not suppose great accuracy, we are authorized in taking A = O.

[TO BE CONTINUED.]

Notes on Belgium. By Captain G. W. Hughes, *United States Topographical Engineer. Addressed to* Francis Markoe, Jr., Esq., *Corresponding Secretary of the National Institution, Washington, D. C.*

[CONTINUED FROM PAGE 164.]

Steam engines are made at Liege, Serainge, Brussels, Molenbeck, Gilly, Tirlemant, Bruges, and Namur. From 1829 to 1835, there were 261 steam engines of 5,400 horses power, built at Liege, since which time the numbers and power have nearly tripled.

Nail making is also a very important branch of industry connected with the mineral productions of this country. The principal factories

are at Liege and Charleroi, at which latter place there are 5,500 workmen constantly employed.

The reputation of the arms fabricated in Belgium is now well established. The principal seat of this branch of industry is at Liege, which numbers, within its jurisdiction, more than fifty manufactories, and most of them in a highly flourishing condition. These products are exported to South America, Egypt, Turkey, Germany, Italy, Spain, and even the United States, where, it is said, they are preferred to the Birmingham arms. Be this as it may, it is a well known fact that gun and pistol barrels, and locks, are sent to England, where they are mounted and *marked*, and sold for *three times* the Belgian prices; but this is owing somewhat to the superior style in which they are finished in England. It is estimated that more than 30,000 stand of arms are annually exported to the Brazils. The following table shows the amount of this species of manufacture for 1836, (the last official statement I have been able to procure,) since which time it has *greatly* increased, and perhaps nearly doubled.*

Sporting guns, (single barrel,) - - -	152,044
" " (double barrel,) - - -	24,846
Boarding muskets, (for ships,) - -	8,438
Holster pistols, per pair, (for Cavalry,) - -	22,086
Pocket pistols, per pair, - - -	70,314
Muskets for Infantry of the Line, - -	71,651
Total of all kinds, - -	349,379
Estimated to be worth -	$ 1,400,000

I have no where seen rifles, (*un fusil rayé*,) mentioned in the returns of arms; yet almost all their *case* pistols are rifled, but so far as I can learn, the American rifle is not much used, and its fearful and deadly qualities, as an offensive weapon, not well understood. The Belgian officers have been not a little astonished (and somewhat incredulous I have thought,) at the accounts I have related of the feats with this arm of some of our Western back woodsmen.

The country embraced between the French frontier and an imaginary line drawn from Ostende to Arlon, comprising the Province of Liege, abounds with building materials, such as marbles, of different kinds, granite, slate, freestone, and lime, of different qualities, including the *hydraulic*, which is much used as a stucco for the exterior covering of houses.

The provinces of Hainault, Namur, Liege, and Luxembourg, con-

* There are more arms manufactured in Liege alone, than in the whole of France; and it even exceeds, in this respect, Birmingham, which is regarded as the great armory of England.

tain many *marble* quarries; the most important of which are in the cantons of Beaumont and Chimai, near Fontaine l'Eveque, Bouvigne, near Rochefort, at Dinaut, St. Medard, and Lesves—the neighbourhood of Phillipeville presents many varieties of them; the black marble of Dinaut is particularly recherché.

The best and most beautiful *slates* (perfectly free from iron pyrites,) are found in the provinces of Namur and Luxemburg. The quarries of Herbeumont are the most important, and yield over 8,000,000 per annum. They sell at the quarry, when well dressed, for about $3 per thousand.

Excellent building stones, and lime stones, occur in the provinces of Namur, Luxemburg, Liege, Limburg, Hainaut, and Brabant. The blue lime stones (les pierres bleues,) found in the vicinity of Dinaut, and at Soignies, are much esteemed.

The most beautiful building stone in Belgium, is the blue carbonate of lime, already mentioned as the pierre bleue, of a fine and compact grain. It is easily cut, and is susceptible of a good polish. It resists the action of air, water, and frost; and is quarried in large blocks, sometimes sufficiently massive to make columns of a single piece, from twenty to twenty-five feet in height. The better kinds of this rock are in much demand throughout the kingdom, and much of it is transported to Holland. It is used in Brussels for the basements, pillars, stair-ways, lintels, and cornices of houses, and for the trottoir of streets, etc. The other portions of the structure are usually built of either bricks, or of a whitish brown free stone, called grés, found in the neighbourhood. It is rather soft when first quarried, cuts easily, and indurates on exposure to the atmosphere. This stone is usually worked in small regular pieces, and when well dressed, forms a handsome façade. The beautiful metropolitan church of St. Gudule, and the celebrated Hotel de ville de Bruxelles, are both being restored with this material; and the partial restoration of the lofty, rich, and towering spire of the latter is already very agreeable to the eye, and cannot fail to produce, when completely finished, a most striking effect. It is highly creditable to the Belgians that, since the revolution, which gave them for the first time since the days of Cæsar, a separate and distinct rank amongst the nations of the earth, the work of restoring the ancient architectural monuments of the country has been carried forward in a spirit of patriotism, liberality, and good taste. This stone, le grés, unites quickly and strongly with mortar; and the pierre bleue is occasionally used as a hydraulic cement.

The blue lime stone of Nivelle, although of the same sub-species with the foregoing, is inferior to it in quality.

This same kind of rock is also found on the banks of the Meuse,

between Namur and Huy; but it cracks and scales off more readily than the Soignes stone, and, when quarried in the winter, does not well resist the action of frost.

The lime obtained from this stone, mixed in equal proportions with sand, and a little hair, constitutes the usual stucco used in Brussels, where *every house*, except those built exclusively of stone, is covered by it. This cement certainly resists the action of the atmosphere most admirably; and the universal practice of plastering the houses, or white-washing them, gives to "Belgium's ancient capital" an air of neatness and lightness but seldom seen in European towns. The best composition for this purpose is a mixture of the cendrie de Tournay and sand, and occasionally a small proportion of common lime. The Tournay cinders are a powder formed by half burning a hard blue limestone, found at Tournay, the debris of which falls through the furnace grates, and is mixed with the (mineral,) coal ashes. This is said to be quite equal to the *Dutch Terrasse*, and is employed for the same purposes. And indeed the Terrasse of Holland, the cinders of Tournay, and the powder of well baked earthen tiles, may be regarded as artificial Puzzolanas, which acquire by heat, the property of solidifying under water.

The *Terrasse de Hollande* is a species of argillaceous earth found near Cologne. It forms, when baked, ground to a powder, and mixed with common lime, a capital cement, which alike resists humidity, dryness, and the extremes of temperature.

Besides the afore-mentioned substance, there is another much used in Holland, and in some parts of Belgium, called Trass, which is a species of lava, and is undoubtedly of volcanic origin. It is divided into two classes; the first is the soft stone of Andernock, (le moellon d'Andernock,) quite fragile, and of a whitish gray colour; the second is known as le moellon de Boul, harder than the first, and of a deeper gray colour, yielding, when ground, a kind of puzzolana which produces, when mixed with an equal quantity of fat lime, a very indurated morter, perfectly impervious to water. The hardest of these moellons are selected for the most important hydraulic purposes, such as dykes and subterranean structures, where it is necessary to prevent the infiltration of water. For ordinary works, the two kinds of powder are mixed in equal proportions, and this forms the article generally known in commerce as "*Andernock*," which is the name of the town where it is found, not far below the junction of the Mozelle with the Rhine. This material is much used for building in the towns on the Rhine and its tributaries.

For the exterior covering of the walls of buildings, the hydraulic

lime of Tournay is commonly used in Brussels, and the mortar is generally composed of the following constituents.

1st. One cubic yard of lime, in paste.

2nd. One and a half cubic yards of sharp sand.

3rd. Fifty pounds of short hair, as it is scraped from hides in dressing them.

These three substances should be well mixed and ground together, and no more water added than may be necessary, to render the mortar tolerably thick and pulpy.

The sand is employed in the condition in which it is taken from the pits, except that it is passed through a rather fine wire seive, to get rid of the small stones, or coarse gravel.

The stucco usually consists of three coats, or layers, each layer being about five millimetres, or a little less than two-tenths of an inch thick; making the whole thickness of the plastering about one-half inch.

After having wet the walls, in order that the mortar may the more readily adhere, the first coat is quickly applied with a trowel. This first layer is called *cripis*, because it produces an extremely rough surface. When the cripis has been perfectly dried, the second coating is laid on, and should be well dressed and smoothed with a ruler, or straight piece of board; and when the cement has acquired a certain consistency, the third and last layer is applied, and carefully dressed and trimmed with a trowel.

The cost of this kind of composition, including materials and labour, is, per square yard, sixty centimes, or about 11½ cents.

The interior walls of houses are plastered in the same manner, and with the same kind of cement, except that *walloon lime* and *fine sand* are employed; and as this lime is much fatter than the hydraulic lime it neutralizes a greater quantity of sand. A mixture of one cubic yard of lime with two cubic yards of fine sand makes an excellent mortar. The price per square yard, of this kind of work, everything included, is fifty-five centimes, or about 10½ cents of our money.

The price of a cubic yard of Tournay hydraulic lime, in Brussels,

is about - - - - - -	$4,00
" of Tournay cinders, per cubic yard,	4,50
" of Walloon lime, - - - -	5,25
" of the pierre bleue, when well cut and chisel dressed, per cubic yard, -	20,00
To which must be added per square yard of surface, cut to mouldings, - - -	4,12½

I deeply regret not having been able to procure the analyses of their various building substances, but it is extremely difficult to ac-

quire information of this kind in Belgium; and indeed the analyses of minerals would seem not to have excited much interest among the savans of this country.

Mill-stones, grind-stones, flints, and whet-stones, have been long known in Luxemburg and Liége; the grind-stones quarried at Nilsalm are among the very best in Europe, and there are about 80,000 of these stones, some of very large size, dressed each year for market; and many of them are sent abroad.

The province of Namur furnishes a very good kind of clay, adapted to the manufactory of Delft ware, potter's ware, and pipes. There is also a very considerable sand bank in Ardennes, which produces an excellent metal for porcelain.

Our Minister to Brussels, Mr. Maxcy, having procured general letters to the industrial establishments of this country, from Mr. Mieus, (a Director of the *Societé Generale*, the great Bank of Belgium, which is connected with nearly all of the large manufactories of the kingdom,) I recently, in company with that gentleman, made an excursion to Charleroi, an important frontier town on the Sambre, for the purpose of examining the productive works of that rich mineral and manufacturing district.

It may be proper to remark that a good deal of caution is observed in admitting strangers to visit manufactories in Europe; and indeed without an order from an officer, or from some person connected with those establishments, it is difficult, if not impossible, to gain access to them; and letters of introduction, for such purposes, are not easily obtained.

We first went to the iron works of Couillet, near Charleroi. They belong to a chartered company called "*la Societé anonyme* de Couillet pour la fabrication de fer." Almost all the works of this kind are joint stock concerns, and when so are usually designated as the Anonymous Society of a certain place, for a specific purpose; and these companies are placed under the *patronage* (as it is called,) of some great Banking Institution, through the agency of which they transact their financial business. The *Observateur*, a Brussels newspaper, has recently published "a table of the different administrations confided to Count Mieus, (Governor of the *Societé Generale*,) the funds of which represent a capital of 233,520,100 francs;" this capital is divided among seventeen financial and industrial Societies.

The iron works of Couillet are truly magnificent, covering more than eleven acres of ground. All the structures are well built, and exhibit a good deal of taste, as well as skill, in their designs.

This establishment contains eight blast furnaces, (hauts fourneaux,) only one of which is at present in activity; and at no time have there

been more than five in operation, owing to the falling off of the iron trade since 1837, (the most of the furnaces having been erected subsequently to that year,) which would have proved still more embarrassing to the iron masters, but for the demands of the government for railway purposes; which were, to a certain extent, anticipated, for succeeding years, in order to lessen the check to this branch of industry. There are twenty-two blast furnaces in the immediate vicinity of Charleroi, but the half of them are not in use at present.

The furnaces at Couillet are forty-five feet high, and fifteen feet across the boshes. The blast is usually hot, and it requires an engine of sixty horses power to work one furnace. With the hot blast the following is the charge.

Ore, - - - -	40 buckets.
Coke, - - -	34 "
Lime-stone, - - -	24 "

With the cold blast the ore is diminished to thirty buckets, while the other substances remain constant.

The materials for the charge are elevated by buckets attached to an endless chain, which passes over two drums, the one at the top, and the other at the foot of the stack, between the two furnaces, and is moved by the steam engine which keeps up the blast. Each furnace yields from ten to twelve tons of pig metal per day. The hearths are built of fire brick, (made at the works,) and last from five to eight years. The coal is found close at hand, but cannot be used to advantage for reducing ores, until coked, which process is here conducted in ovens, of which there are a great number.

In Wales the coking is usually done in the open air, very much in the way wood is carbonized in the United States, by covering it with earth; but this is a wasteful mode of operation. The coal about Couillet yields from sixty to seventy per cent. of coke—the first for the refineries and the second for the blasts. The deepest coal pits in this district are from 900 to 1200 feet below the surface. The best coal is taken from a bed four and a half feet thick. They find but little iron ore with the coal, and those used are the limonites, brought from a distance of three or four miles, and yield from thirty-five to forty-five per cent. of metal. Sulphuret of lead is sometimes found in considerable quantities with the iron ore.

The rolling mills and forges are very extensive, and embrace the latest and most approved English and German improvements.

An engine of sixteen horses power moves two immense trip hammers at the same time; they are kept in motion by a large revolving cylinder with cogs; and as these cogs trip the hammers, they fall on

the heated metal below. With these hammers they have forged masses of metal weighing 4000 lbs. The best metal is made in this way, and is not rolled, except once, when taken from the puddling furnaces. When very strong iron is required, several bars are heated, and welded together, by these ponderous hammers; the *best* quality of iron brings, at this time, 400 francs per 1000 kilogrammes, or about $80 per ton. With the hammers are connected two enormous pairs of shears, which seem to meet with scarcely any resistance in cutting through rods of iron of two and a half inches diameter.

We went next to the machine shop for the fabrication of steam engines, screws, tools, &c., used for turning and planing castings. We here noticed a large mortising machine (for cutting mortises out of cast iron,) made by Sharp, Roberts & Co., of Manchester. An engine of twenty horses power is connected with this shop. It is proper to remark that all the steam engines employed in these works were made here. They are of the English form, and perform well. It is but just to the Belgium manufacturers to say, that whatever they *do* they do *faithfully;* in illustration of which I will mention that the minister of public works, in his report for 1840, states that not a single accident, producing any serious personal injury, occurred during that year, amongst the numerous steam engines in constant use; of which, I think he said, there were between 11 and 1200.

The foundry is also extensive, and the arrangements are adapted to the casting of very large pieces. The day of our visit they cast an iron plate for the Oignies glass works, of the following dimensions: 18 feet × 10 feet × 0.5 feet. It is quite difficult to cast so large a plate smoothly, and without flaws, and the first effort is seldom successful. The *form*, or *mould*, is prepared with bricks carefully laid, and then covered with a composition of sand, clay, and coke, hard rammed, and made as smooth as possible. The melted metal is run from the furnace into iron pots, connected with cranes, by which they are moved. When full, these pots weigh 1200 lbs., and are easily manœuvred by one man. It is essential to the success of the operation that the melted iron should be poured into the mould *precisely* at the very same time from all the pots, and from, at least, four different directions, else the several currents of metal will not perfectly unite. Another necessary precaution to be observed, is to guard against the danger of an explosion of the steam beneath the form, generated from the moisture, which it is found impossible completely to expel. To remove this difficulty, iron pipes, to carry off the vapour, are laid, in an inclined position, with one orifice under the mould, and the other exposed to the air. As soon as the plate becomès solid it is covered with sand, and left to cool slowly, which takes five or six days. It

is then planed quite smooth before it can be used for its destined purpose, the casting of large plate glass for mirrors.

In the rolling mills are two steam engines, respectively of sixty and eighty horses power. They were rolling arched rails for a Siberian railway, while we were present, of forty-four pounds to the yard. The iron, after being refined, is puddled, rolled, welded, and rolled four times, before it is carried to the pattern roller, and passed seven times through them before the process is completed. The railway chairs which we saw cast weigh eighteen pounds each.

There are 450 men employed in these works, exclusive of those engaged in the mines, and in transporting the raw materials. Some of the work is paid for in proportion to the quantity, but most of the workmen are hired by the day, their wages varying from two to three francs.

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Cost of Excavating Earth, by Means of Scrapers, or Scoops.
By Ellwood Morris, *Civil Engineer.*

Of all machines known to American Engineers, and used upon our public works for the excavation of earth, and its removal to short distances, the *scraper, or scoop*, is, within its proper sphere of influence, by far the most economical.

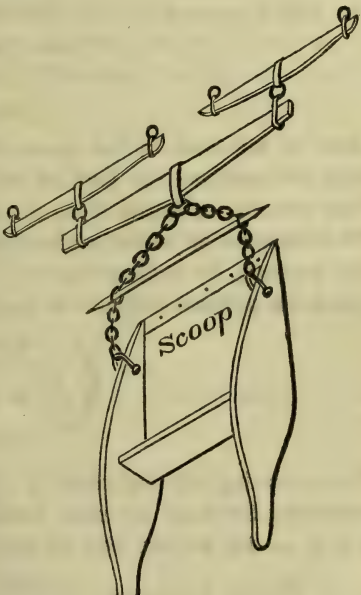
This instrument is particularly well known to Canal Contractors, much used by them in earth cuttings, and most frequently employed in excavating the trunks of canals, where they are so laid out that the cutting makes the bank, or nearly so; but the *scoop* may be used with success in all excavations of earth where the slopes do not exceed $1\frac{1}{2}$ to 1, if the material to be taken out yields readily to the plough, and is not required to be moved horizontally more than 100 feet, nor to vertical heights exceeding 15 feet; there are doubtless instances where both these limits may be surpassed, and the use of the *scoop* still be highly economical, but such cases are not general, and the practical scope of the utility of *scoops* may be regarded as confined to the excavation of canal trunks, and the formation of low road embankments from side trenches, for both of which purposes it is most admirably adapted.

This machine is drawn by two horses, managed by a boy, and usually requires the ground to be first ploughed; then by simply elevating and guiding the handles a little, the driver causes it to load itself, for the horses being in motion it turns in its clevisses, and inclining downward, runs under the loose dirt like a plough; the handles being released, the loaded *scoop* moves upon two iron shod runners

which form the sides, and project below the bottom, and finally after reaching the place of deposit, the handles being smartly elevated, the edge of the *scoop*, which is armed with iron, takes hold of the bank, and the horses moving on, it overturns and discharges its load; in this overturned position, with the handles resting on the double tree, it returns upside down to the place of excavation, and is there loaded, &c., as before.

Although for successful scooping the ground usually requires loosening, and must not be so hard as to resist the plough; it is often the case, especially in sandy material, that it is so soft that the scoop, by its armed edge, is able to excavate it, and load itself, without any previous loosening of the earth.

All this will be rendered so evident to the reader, by an inspection of the annexed isometrical sketch, showing *a scoop*, with its double tree, and single trees, that any further description of the mode of operation seems to be entirely unnecessary.



The writer pursuing his object of acquiring, from actual experiment, a knowledge of the cost of excavating materials and forming embankments upon public works, early addressed himself to observe the effect produced by scoops, and the results of numerous observations upon scooping earth to horizontal distances of from 30 to 80 feet, and heights of 5 to 15 feet, where the slopes are 2 feet base to 1 foot rise, established in a satisfactory manner the following data:

1. That taking average earth (yielding readily to the plough,) at mean stages of weather and seasons, *a scoop load* may be taken at *one tenth of a cubic yard measured in excavation.*

2. That the time lost in loading, unloading, and all other ways, per load (except in turning,) is, at an average, *two-thirds of a minute.*

3. That in every complete turn, or semicircle, described by the horses, *one-third of a minute is lost.*

4. That if the mean horizontal distance of transportation of the earth in a right line, *be added to* the extreme height scooped, measur-

ing vertically from the bottom of the excavation to the top of the bank, then for every 70 feet of this aggregate distance, *one minute* will be consumed by the horses in going out and returning back.

5. That if the earth be all scooped to *one side*, as for instance, to the tow-path bank alone, of a canal, *two turns, or a complete circle*, will be made by the horses, for every load deposited in bank.

6. That if the earth be scooped to *both sides* of a canal, but *one turn, or a semicircle only*, will be described by the horses, for each load put in bank.

From the 5th and 6th observations, it follows that clear of the time needed to overcome the horizontal haul and vertical height, the constant amount of time lost per load, will be:

In Double Scooping.—Time lost in loading, &c., $= \frac{2}{3}$ minutes.
Do. in turning *once*, $= \frac{1}{3}$ "

Total, - - $= 1$ "

In Side Scooping.—Time lost in loading, &c., $= \frac{2}{3}$ minutes.
Do. in turning *twice*, $= \frac{2}{3}$ "

Total, - - $1\frac{1}{3}$

Now if the sum of the mean horizontal haul, and the extreme height scooped, both in feet, be put - - $= a$

The number of hours wrought per day, - - $= b$

The number of cubic yards excavated and placed in bank, per day, by each scoop, - - - - $= x$

Then the general formula to find x in *double scooping* will be:

$$\frac{\left(\dfrac{60}{\frac{a}{70} + 1}\right) b}{10} = x.$$

Transforming this equation by the rules of algebraic fractions, and substituting for b the average number of hours commonly wrought per day, $= 10$, we are able to reduce the formula to the following:

In Double Scooping, $\dfrac{4200}{a + 70} = x$ . . . I.

And for *side scooping* the general formula will be:

$$\frac{\left(\dfrac{60}{\frac{a}{70} + 1\frac{1}{3}}\right) b}{10} = x.$$

Transforming which, by the rules of algebraic fractions, we have:

In Side Scooping, $\frac{4200}{a + 93\frac{1}{3}} = x$ . . . . . II.

Now putting *the cost per cubic yard of excavation put in bank clear of all profit,* - - - - - $= y$

The daily wages of a scoop and driver, in cents, $= c$

The cost per cubic yard, in cents, of loosening the earth, $= d$

The formula to find y, the cost in cents per yard, either in double or single scooping, will be:

$$\frac{c}{x} + d = y \quad - \quad - \qquad \text{III.}$$

The actual number of cubic yards excavated and put in bank by *scoops,* in several instances, having become accurately known to the writer, the correctness of the formulæ I and II will be tested by those cases.

Example I. Double Scooping.

In this case, 3600 cubic yards of earth were excavated and put in bank by 90 days work of *scoops,* or per scoop, per day, = 40 cubic yards, - - - - - - $= x$

The mean horizontal haul was $= 26\frac{1}{2}$ feet.

The extreme height scooped, $= 8$

Aggregate distance, - - $= 34\frac{1}{2}$ $= a$

Then by the formula I we have:

$$\text{I.} \quad \frac{4200}{a + 70} = x \text{ or } \frac{4200}{34\frac{1}{2} + 70} = \frac{4200}{\frac{209}{2}} = \frac{8400}{209} = 40\tfrac{2}{10} \text{ c. yds.} = x.$$

Here the calculated and actual days work of the scoops is the same within $\frac{2}{10}$ of a cubic yard.

Example II. Single or Side Scooping.

In this case, 5000 cubic yards of earth were excavated and deposited in bank by 176 days work of scoops, or per scoop per day, = $28\frac{1}{2}$ cubic yards, - - - - - $= x.$

The mean horizontal haul was $= 44$ feet.

The extreme height scooped, $= 11$ "

Aggregate distance, - - - $= 55$ - - $= a.$

Then by the formula II we have:

$$\text{II.} \quad \frac{4200}{a + 93\frac{1}{3}} = x \text{ or } \frac{4200}{55 + 93\frac{1}{3}} = \frac{4200}{\frac{445}{3}} = \frac{12600}{445} = 28\tfrac{3}{10} \text{ c. yd.} = x.$$

Here the difference between the real and calculated days work of a scoop is $\frac{1}{5}$ of a yard.

Conceiving it to be unnecessary to display at length any more of the examples, we will embody, in the following table, the results of actual experiments, and compare them with those calculated by the formulæ.

1	2	3	4	5	6	7	8	9	10
No. of experiment.	Kind of scooping.	Mean horizontal haul.	Extreme height scooped.	Value of a. or sum of cols. 3 and 4.	No. cub. yds. excavated & put in bank.	Days work of scoops employed in doing the work stated in column 6.	No. of cubic yards actually excavated per day by each scoop.	No. of cubic yards excavated per day per scoop; calculated by formulæ I. and II.	Cost per cub. yd. of the excavation calculated by formula III.
1	Double.	$26\frac{1}{2}$	8	$34\frac{1}{2}$	5000	126	$39\frac{7}{10}$	$40\frac{2}{10}$	$7\frac{8}{10}$
2	Double.	$26\frac{1}{2}$	8	$34\frac{1}{2}$	3600	90	40	$40\frac{2}{10}$	$7\frac{8}{10}$
3	Side.	44	11	55	5000	176	$28\frac{5}{10}$	$28\frac{3}{10}$	$10\frac{7}{10}$
4	Side.	36	6	42	5610	181	31	31	$9\frac{9}{10}$
5	Side.	40	9	49	852	$28\frac{1}{2}$	30	$29\frac{1}{2}$	$10\frac{3}{10}$

In calculating column 10 of the above table, the hire per day of a *scoop and driver*, has been assumed to be 275 cents, and the cost of loosening, at 1 cent per cubic yard.

The near coincidence of the results in columns 8 and 9, shows how closely the calculated number of cubic yards, excavated per day, in each of the kinds of scooping, agrees with the real days work *of each scoop*, as actually ascertained in excavating 20,062 cubic yards of earth; consequently we may regard the formulæ which we have deduced, *as being sufficiently confirmed to justify a full reliance upon them in practice.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Compression of Earth, and the Increase of Rock in Embankment, Compared with the Volume in Excavation. By ELLWOOD MORRIS, *Civil Engineer.*

I. *On the Compression of Earth in Bank.*

It is well known to practical engineers, that when earth is excavated and formed into embankment, it occupies *less space in bank* than in the cut whence it came.

Although experience has sufficiently established this fact, yet a contrary opinion is often entertained by persons who have not bestowed much attention upon such affairs; and this idea is encouraged by inadvertent paragraphs, which are sometimes met with in works of high professional authority.*

Thus even in Professor Mahan's able treatise upon Civil Engineering, (page 118,) we find the following sentences:

"In determining the relations between the volumes of the embankments, and the excavations by which they are furnished, it must also be borne in mind that earth, in its natural state, occupies less space than when broken up; and as the embankments, when first formed, are in the state of earth newly broken up, an allowance must be made according to the nature of the soil. This allowance will generally vary between one-twelfth and one-eighth; that is, earth, when first broken up, will occupy from one-twelfth to one-eighth more bulk than it does in its natural state."

Now, so far from this being the case with embankments of earth, it is directly the reverse, and the fact is in practice, that the *compression*, and not the *expansion*, of earth, when formed into bank, is usually found to be from *an eighth to a twelfth part* of its volume in the natural state.

Although it is evident that a subject of this nature does not admit of a precise determination, because an almost endless variety exists in the consistency, and hence in the compressibility of earths; still it is quite possible to form an approximation which will not, in general, err very far.

A few years ago the writer made some observations upon embankments formed from excavations, in three different cases, and upon a tolerably large scale, where the accurate cubic content, both of cut and bank, was known, and the amount of the latter exceeded *thirty-nine thousand* cubic yards.

The details of these experiments, all of which refer to banks formed in layers by cart and scoop, are to be found in the following statement, of which we may further observe, that one winter intervened between the commencement and completion of each bank.

* The most common error upon this subject, which we meet with in books, is the supposition that a certain amount of earth excavation, will form the same quantity of embankment; which, in practice, can never be the case in banks that are made with carts.

Thus in Professor Millington's excellent "Elements of Civil Engineering," we find it stated (at page 184,) that by a particular arrangement of levels, "one-half of the canal will be in excavation, and the remaining half in embankment, and the soil that is dug out of one end will serve to form the embankment at the other." The same idea runs through other works, which we might quote if it were necessary.

Number of the embankment.	Earth excavated to form each embankment.	Embankment made by the preceding quantities of earth.	Shrinkage or compression of the earth in bank.	Rate of the compression of the earth in bank.	Remarks.
	Cubic yards.	Cubic yards.	Cubic yards.	Cubic yards.	
1	6970	6262	708	$\frac{100}{984}$	Yellow clayey soil.
2	25975	23571	2404	$\frac{100}{1080}$	Ditto.
3	10701	9317	1384	$\frac{100}{773}$	Light sandy soil.
Total.	43646	39150	4496	$\frac{1}{10}$ average compression.	

By these tabulated observations, we perceive that 43,646 cubic yards of earth, transferred from its natural locality into the embankment of a public work, suffered by the operation a diminution, or shrinkage, in bulk, of 4,496 cubic yards, or *one-tenth* of its mass.

Some other observations, upon a smaller scale, indicated that the compression which took place in *gravelly earth*, when used for embankment, amounted to about *one-twelfth* of its bulk in the cutting.

Consequently, at least until more ample experiments are made, these results seem sufficient to justify the assumption of the following rates for the *compression of earth in bank*,* viz.

In light sandy earth,	$\frac{1}{8}$	of the volume in excavation.
In yellow clayey earth,	$\frac{1}{10}$	"
In gravelly earth,	$\frac{1}{12}$	"

In computations made for the purpose of equalizing the excavation and embankment upon roads, canals, or railroads, a strict attention to

* As an example of the practical operation of these principles; suppose a contractor to have undertaken the formation of an earth cutting, and a contiguous embankment of greater amount, in which the earth excavation is to be used.

Let the amount of the earth cutting = 25,000 cubic yards at 25 cents per cubic yard.
" Embankment = 40,000 " at 30 cents per cub. yd. for that *not from cut.*

Then if we neglect *the compression of earth in bank*, there would be but 15,000 cubic yards of embankment not from excavation, and the amount of the contract would be,

25,000 cubic yards excavation of earth, at 25 cents, .	= $ 6,250
15,000 cubic yards embankment, *not from cut*, at 30 cents,	= 4,500
Total,	= $ 10,750

But as we have shown above, that the earth, when formed into bank, would, in fact, com-

the above considerations is indispensably requisite; for if they are neglected, it will be found that excavations, which have been laid out as sufficient to furnish the materials for a given embankment, will be deficient in quantity, and an unexpected resort to side cutting will become necessary to complete the bank, as has been witnessed by the writer in more than one instance.

In tracing out a canal, if the depth of cutting sought by the centre line, as necessary to form the banks from the excavation of the trunk, has been calculated without due allowance for *the compression of earth in bank*, the trunk of the canal will not supply material enough, and a resort either to cutting below bottom, or to side trenches, will become unavoidable, to make up the amount deficient.

II. On the Increase of Rock in Bank.

By careful observations made by the writer, it was found that the excavation of 22,625 cubic yards of *hard sand-stone rock, which quarried in large fragments*, formed 32,395 cubic yards of embankment; showing that in this instance, the increase of the rock in bank was 9,770 cubic yards, or about *five-twelfths* of its volume measured in the cut.

In another case, it was noticed that the excavation of 16,982 cubic yards of *blue slate rock, that broke up into small pieces*, formed 27,131 cubic yards of embankment; showing that here the increase of the rock in bank amounted to 10,149 cubic yards, or nearly *six-tenths* of its measured bulk in the cutting.

From these observations, made upon the increase of near *forty thousand* cubic yards of rock-cutting carried into bank, it would seem that the augmentation was about *one-half;* but as in lime-stone, and other rocks, it might be found to vary, both with their relative frangibility, and the dimensions of their quarried fragments, more ex-

press, or shrink, about one-tenth; the actual quantity of embankment which it would be necessary to supply *not from excavation*, would be as follows:

Gross amount of the bank, ...	= 40,000	cubic yards.
Bank made from cut $= 25{,}000 - \frac{25{,}000}{10}$	= 22,500	"
Leaves embankment *not from cut*, ...	= 17,500	"

And the amount of the contract ought really to be,

25,000 cubic yards excavation of earth, at 25 cents,	= $ 6,250
17,500 cubic yards embankment *not from cut*, at 30 cents,	= 5,250
Total,	$ 11,500

This last amount being $ 750 *greater* than the former, shows how injuriously the interests of undertakers of works might be affected, if we failed to make due allowance, in calculating deficient embankment, for the *compression of earth in bank.*

periments upon this point appear to be necessary to enable correct rules to be framed.

Philadelphia, September 1st, 1841.

Railways in Germany.—Emperor Ferdinand's *Northern Road.* (*From Vienna to Bochnia, in Galicia, with Branches.*)

CONTINUED FROM PAGE 180.

The project for this railway, which is the most extensive as yet undertaken in Europe, was conceived already in 1830; from that time up to the year 1836, various local investigations, as well as an examination of the railways executed in England and Belgium, had been made by the banking house of Baron Rothschild, in Vienna, to whom, on application, the imperial privilege was finally granted, on the 4th of March, 1836, authorizing the formation of a Company of shareholders for the construction of a railway from Vienna, the capital of the Austrian empire, to Bochnia, in Galicia, with branches to Brunn, Olmutz, Troppau, Dwory, and Wielitchka. The provisions of this charter are of the most liberal nature; in regard to the right of way the same laws are to be observed as in the establishment of public turnpike roads by Government; no restrictions are made as to the tariff, and during fifty years no rival railway can be constructed between the above designated points. After fifty years the privilege expires, but may be renewed, the road and appurtenances remaining to the Company for ever.

Immediately after, an arrangement was entered into between the house of Rothschild and a provisory committee, formed by the first subscribers to the stock. Subscriptions were received for 6,000 shares (at £100,) which, with the 8,000 retained by the owner of the privilege, for himself and his friends, formed a capital stock of £1,400,000 (fourteen millions of florins.) This amount was deemed sufficient for the accomplishment of the work. The instalments were made at £10 every half-year, the first on the 30th of April, 1836, the last on the 15th of October, 1840; from the time of the first payment, made by the stockholders, they receive an interest at the rate of 4 per cent. per annum.

The charter provided that five miles of the railway were to be completed within two years, and the whole line to Bochnia within ten years from the day the privilege was granted. Accordingly, with the necessary means on hand, operations were immediately commenced, by making the surveys and plans for the section from Vienna to Brunn; the ground was first broken on the 7th of April, 1837, and the works prosecuted with the utmost vigour, from 10,000 to 12,000 labourers having been constantly employed on the line. Already, in November of the same year, the first trips were made to Wagram, a distance of seven miles; in August, 1838, nineteen miles of the railway were put into operation, and the whole line to Brunn, of ninety-one miles in length, was opened on the 7th of July, 1839, or in two years and three months after the commencement of the work. At

the same time the works in the main line towards Galicia were steadily progressing, and on the 1st of November, 1840, the following sections were nearly completed:—

	Miles.
From Vienna to Lundenburg and Brunn, (opened,)	91
" Lundenburg to Hradish, (main line,) - -	30
" Near Vienna to Stockerau, (a branch,) -	14
Length of railway completed, or nearly so, - -	135
The following sections are in progress of construction:—	
From Hradish to Prerau (main line,) - - -	30
Branch to Olmutz, - - - - -	15
Total completed and in progress, - - -	180

At the same time the surveys are now making for the other parts of the main line, and those branches yet to be constructed. The total length of the railway, with all its branches, will not fall short of 400 miles, which is certainly the greatest extent of any work of this kind yet undertaken in Europe by a single Company. The total amount already expended exceeds ten millions of florins, or one million sterling.

The railway derives its name from its traversing the northern provinces of the empire; amongst its principal objects is the transportation of oxen from Galicia to the Residence, the number of which, according to official data, amounts, annually, to more than 90,000. It will, in every case, contribute largely to develop the resources of those provinces, and become the more important by the connexion with the Warsaw and Vienna railway, now in progress. An uninterrupted line of railway will then exist between the Vistula and the Danube, connecting the Baltic with the Black Sea.

In the following a more detailed account is given of the construction, management, and operations of that part of the Emperor Ferdinand's Northern Railway, which has been for some time in use, viz. of the line from Vienna to Brunn, the capital of Moravia.

The railway commences at the Prater, a little distant rather from the centre, but still within the barriers of the city and suburbs. There is a spacious station, with extensive buildings for the passenger and freight departments, and for the repairing of engines and cars, destined to accommodate not only the line to Brunn, but of the whole railway. After leaving the depot, the railway crosses two arms of the Danube, by wooden bridges, which are both 1,960 feet in length. These bridges are built very light, in order not to put a permanent obstacle against the floating ice during the spring freshets, the accumulation of which might otherwise cause an inundation of the adjoining country. Having crossed the valley of the Danube, the line pursues a north-eastern course, and reaches the river March, which forms the boundary between Lower Austria and Hungary. After following, for a considerable distance, the course of this river, it crosses the Thaya at Lundenburg by numerous bridges. There, at a point

fifty miles from the city of Vienna, the branch road to Brunn parts from the main line, and follows the course of the Thaya and Shwarza until it reaches that capital, while the main line pursues its course in the valley of the March. The railway, although not very direct in its course, has, notwithstanding, several straight lines of considerable length, and the curves are all of very large radii. The whole distance from Vienna to Brunn is, as already mentioned, ninety-one miles.

The railway rises gradually towards the north, with moderate grades. The steepest inclination is nineteen feet per mile, and occurs only once for a short distance. The first nineteen miles of railway are graded for a double track, in order to accommodate a branch, which is to lead to Presburg, in Hungary; the remainder will only have a single track. The excavations and embankments were in some parts very considerable; the greatest height of the latter is thirty-eight feet. At Brunn the railway terminates upon a long viaduct over the valley of the Shwarza, consisting of eighty arches, seven of which have a span of thirty-one feet, the others of twenty-five feet. The total length is 2,383 feet. Of the works executed the following will give the best idea:—Excavations and embankments, 6,012,500 cubic yards, of which 140,000 cubic yards were excavation in solid rock. Length of wooden bridges, 3,708 feet; length of wooden bridges with stone abutments and piers, 488 feet; number of stone bridges and viaducts, twenty-four, with 228 arches; number of culverts, 116; of road crossings, 198; of which thirty-one are under, six over, and the remainder level, with the railway.

The superstructure is made as follows:—Cross ties of wood, formed of half trees of oak, larch, or fir, seven and three-quarter feet in length, and twelve inches in diameter, are laid three feet six inches from each other, upon a layer of gravel, twelve inches thick. Iron rails of forty pounds per yard, of the common T pattern, rest in chairs upon every sleeper, and are kept fast by iron keys, or wedges. The chairs used at the joints of the rails weigh fourteen pounds, the others, ten pounds. The width of the track is four feet eight and one-half inches. The rails were partly imported from England, and partly manufactured in Austria, but owing to the high freight and duty upon the imported rails, and to the inexperience in the manufacture of this article at home, the cost per ton of rails delivered to the road was in both cases not less than from £27 to £27¼. The price of the chairs was £9 per ton.

Besides the principal station at Vienna, which was mentioned above, there is a similar large one at Brunn, and smaller buildings are on nine intermediate stopping places on the road, containing also cisterns, in which the water is heated before it is filled into the tenders. There are besides, along the line of the railway, eighty small houses, for as many watchmen.

For carrying on the transportation business the Company own now twenty-two locomotive engines, of which seventeen were built in England, two in Belgium, two in America, and one in Vienna. Of the engines constructed in England, twelve are from Messrs. Robert

Stephenson and Co., two from Jones and Co., two from Turner, Evans and Co., and one from G. and J. Rennie. All the English engines have six wheels, the driving wheels, as usual, in the middle. The two American locomotives were manufactured by William Norris, of Philadelphia; they are much smaller than the English, have also six wheels, but the driving wheels are behind, and the fore wheels supporting a truck, movable round a centre. These latter wheels are only thirty inches in diameter. Another engine is to arrive in a short time from Philadelphia, from the known manufactory of Messrs. Baldwin, Vail & Hufty, which has furnished, since 1832, over 150 engines for the American railroads, and two more engines are expected from Messrs. Sharp, Roberts and Co., of Manchester.

The passenger carriages used upon the railway are of three different classes, and built, as in England, all upon four wheels. The same is the case with the freight wagons; both carriages and wagons are built in the Company's own shops.

The following was the expenditure for the railway from Vienna to Brunn, up to the 1st November, 1839:—

	£	s.
For preliminary surveys, &c., - - -	2,655	18
Right of way, - - - -	48,721	14
Grading and bridges, - - - -	136,070	18
Superstructure: labour, - - -	38,603	0
" timber, - - -	26,555	8
" iron, - - -	167,274	5
Turnouts and turntables, - - -	3,917	16
Station buildings, work-shops, watch-houses, furniture, utensils, and tools, - - -	22,297	12
Engines and carriages, &c., - -	40,510	9
Cost of administration, - - -	3,096	14
Interest paid to stockholders, - -	15,626	8
Total, - - - -	505,330	2

Since the 1st of November, 1839, there have been expended about £32,000 more, making the total cost of the railway, with buildings, locomotives, carriages, &c., equal to £537,000. This is for seventy-two miles of single, and nineteen miles of double track. This sum divided by ninety-one gives the average cost per mile of railway, with all appurtenances, £5,900, including also the interest on the capital of construction up to the time the line has been opened.

The chief engineers of the railway were Messrs. Ghega and Bretschneider. On the opening of the whole line, the 7th of July, 1839, four trains, with 1,200 persons, started from Vienna, and reached the capital of Moravia in four hours. In returning, however, a sad accident occurred at one of the stations, by the concussion of two trains following each other too closely: several persons were more or less severely injured, much to the disappointment and grief of the Directors, who saw the festival end in such a melancholy manner. This and some further accidents, which may happen on every railway,

particularly in the first period of its operations, tended much to bring the undertaking into discredit amongst the public, and occasioned some severe measures and investigations on the part of the authorities.

The Vienna and Brunn railway is used for the transportation of both passengers and freight. The former are conveyed in three different classes of carriages, and pay for the whole distance, in

Carriages of 1st class, - -	12s. or 1.582d.	per mile.
" 2nd class, -	8s. or 1.005d.	"
" 3rd class, - -	6s. or 0.791d.	"

Each passenger is allowed forty pounds of baggage; if the weight is greater, he has to pay at the rate of 0.42d. per cwt. per mile. Passengers may procure receipts for their baggage by paying 2d., and can, in such case, deliver the latter the day previous to their departure. If the baggage be lost on the road they can recover the amount of £2 10s. for a trunk, £1 10s. for a valise, and 10s. for a parcel; but may, if they choose, also insure the whole value of the baggage; the rate of insurance being one-tenth per cent.

In summer two trains are daily starting from each end of the line, one early in the morning, and one in the afternoon; in winter, one train from each end is sufficient. The passenger trains travel at the rate of twenty to twenty-three miles per hour, and perform the whole distance in from five to five and one-half hours, including stoppages at nine intermediate stations.

Freight is carried in extra trains, with an average speed of fourteen miles per hour. Passengers going with the freight trains pay two-thirds of the usual fare. The charges for freight are different, according to the specific weight and value of the articles; in the tariff all articles are divided into four classes, and the charges are, for articles of the first class, 1.9d. of the second, 2.3d.; of the third, 3.1d.; and of the fourth, 3.9d. per ton, per mile: the average charge for freight is, therefore, 2.8d per ton, per mile. Parties preferring to load a whole wagon pay from 2s. 6d. to 3s., the load, in such case, not to exceed three and one-third tons. The Company guarantee only for such goods as have been insured by the proprietors; the rate of insurance is fixed at one-twentieth per cent.

The income of the road has been constantly on the increase since it was put into operation. In the year 1838, from April to October 31st, when only a small part of the line was in use, the income from passengers amounted to - - - £ 3,346 5s.

From 1st November, 1838, to 30th April, 1839, upon nineteen miles, the number of passengers carried was 58,143, the income, - - -	2,706	17
From 1st May to 7th July, 1839, the length of road in operation nineteen to fifty miles; number of passengers conveyed, 65,994, income, - -	4,238	12
From 7th July to 31st October, 1839, the whole line in operation; passengers, 139,749; income, -	18,070	12
Income from freight, - - - -	704	3
Total to 1st November, 1839, - -	£ 29,066	9

The revenue in the six months, from 1st of May to 1st November, 1839, amounted to £ 23,013 7s.; in the corresponding half year of 1840, the revenue was:—

From 144,354 passengers, - - -	£ 26,163	18s.
" 18,616 tons of goods, - -	11,466	12
Total, - - - - -	£ 37,630	10

This gross income is at the rate of fourteen per cent. per annum, on the capital of construction of £537,000.

The Directors have not yet published their report for the year 1840, from which the expenditure for managing the road could be ascertained for this last year. The following is an account of the expenditure for the period of six months, viz. from 1st May to 1st November, 1839. It is to be considered that the average length of railway in operation during this period was only 72 miles.

For salaries to persons in the technical department, viz:—to engineers, assistants, and superintendents,	£ 632	1s.
Watchmen on the line and stations, - -	747	1
Persons in the transportation department, viz., collectors, conductors, &c., - - -	471	3
Persons in the mechanical department, viz. superintendent of work-shops, engine, and firemen, &c.,	1,113	11
Wages to men repairing railway, - -	531	14
Traveling expenses, remunerations and damages,	222	13
Office expenses, printing, &c., - - -	699	16
Equipments, utensils, requisites, &c. of persons employed in the different departments, -	354	12
House rent in Vienna and Brunn, - -	41	11
Repairs of engines and cars, - - -	1,719	12
Oil, hemp, tallow, soap, candles, grease, &c., -	736	10
Torches and signals, - - -	103	4
Fuel: stone coal, and coke, - - -	5,275	17
" wood, - - - - -	278	13
" oil cakes, - - - - -	10	17
General expenses: administration, and some extraordinary charges, - - - - -	720	8
Total expenditure in six months, -	£ 13,659	3
Recapitulation: income from 1st May to 1st November, 1839, - - - - -	£ 23,013	7
" expenditure ditto, - -	13,659	3
Net profit, - - - - -	£ 9,354	4

The expenditure amounted, therefore, to near sixty per cent. of the gross receipts, and the net profit was one and three-quarter per cent. of the capital invested, in the six months above mentioned. In the year ending 31st of October, 1840, the net revenue has amounted, probably, to at least six per cent. on the capital expended.

The reason of the great expenditure is, principally, the high price of coke and coal, which makes the item of fuel amount to over forty per cent. of the total expenses. The coal, of which the Company make their coke, has to be brought from a very great distance, and a ton of coke has cost them, hitherto, not less than £2 14s. The use of wood has been tried, but abandoned again, on account of the sparks.

[TO BE CONTINUED.]

Architecture.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Alleged Degeneracy of Modern Architecture. By ROBERT CARY LONG, *Architect, Baltimore, Maryland.*

I have noticed, with great pleasure, that in the new series of the Journal of the Franklin Institute, a place has been set apart for architecture.

This is as it should be. It is as well the duty, as the interest, of architects, to enlighten public opinion on the subject of their profession; their duty, because the art they practice is in a high degree refining and ennobling in its influences on the public mind; their interest, because architects cannot live unless the value of the art is recognized, understood, and properly appreciated. People understand, well enough, that they should be careful in choosing those who are to represent them in legislative assemblies; but how lamentably do they neglect that art, whose products represent them, not only to the present age, and in the eyes of cotemporaries, but which are to declare to future generations "what manner of men they were."

In the present condition of things, the enlightenment of public opinion will unquestionably depend on architects themselves, as there are none others who seem to know or care much about it.

As an earnest of *my* interest in the subject, I am induced to disburden myself of sundry thoughts which have suggested themselves, from constantly meeting in the foreign reviews and magazines, the oft-repeated allegation of "the degeneracy of modern architecture."

What do the critics mean by "degeneracy of modern architecture?" It is a stereotyped phrase used by both great and small writers, and, by the frequency of it, we cannot but believe that it means something. When we look, however, into the books, or consult the magazine-articles of said critics, we are puzzled to find out, exactly, what this something is.

If we listen to some of them, we must needs conclude that there never was any architecture but the Gothic, and that there never will be any again until the Gothic is *revived,* thus admitting that Gothic

architecture is now dead, in a stupor, or else has fainted away in very weakness.

From another set of essayists, we learn that Palladio first invented that thing called architecture; that, before his time, people built, "every man according to what was right in his own eyes," until Palladio taught them better, and gave such unerring rules for the production of design in architecture, showing so indisputably what is beautiful and what is not, that thence forward the simplest tyro in art need never go astray.

Hear also your modern Greek, swelling with all the grandeur of the age of Pericles, and familiar with the proportions of the Parthenon, he will tell us that other nations have, in divers ways to be sure, built temples; the Egyptians, for instance, had a few, and in the dark ages, among the barbarians of Europe, a strange kind of a structure, called a cathedral, was erected in a most barbarous manner, without columns, entablatures, or pediment; the principal characteristics being great overgrown windows, and sharp spires, or steeples, running up into the air; all this, however, they aver, was not architecture, because architecture consists of three orders, and a building that has not one of these three orders is of no order of architecture, but is mere disorder, and cannot, in the nature of things, be considered as a production of architecture. Indeed, it may be questioned, whether the veritable temple of Solomon, built by the wisest man on the earth, and according to the express directions of the Almighty, or that tabernacle which Moses built, "according to the pattern shown him on the Mount," if discovered by these modern Greeks to be of no one of their three orders, would not be pronounced by them to be entirely out of proportion, and that the builders must have made a mistake, certainly had never read Vitruvius.

Widely, however, as these scholiasts differ, there is one point upon which they all agree, and this is, they all equally deplore the *degeneracy* of modern architecture, and cry loudly for the *revival* of some one favourite style, in order to regenerate the defunct art.

But let us inquire what do the critics mean by "the degeneracy of modern architecture." Is it degenerate because it is not Gothic; because it is not Greek, not Palladian, not Elizabethan, not Egyptian? If so, then in truth we say, architecture will never be any thing else but degenerate, unless we either turn Greeks, or Romans, or Egyptians, &c., and assuredly no one believes that such is ever going to be the case.

Yet why are architects taking it for granted that nothing is architectural unless it be either Greek or Gothic, or some other style, and that, if drawing from these sources they did not try to throw into

their designs a portico, a pediment, or fasten buttresses and pinnacles to the outside walls, or shape the door and window heads into some particular curve, or arch, or indeed apply any other features which can be taken entire out of books, that all trace of architectural art would vanish from the earth? These are *civilized* times, and men require houses to live in; they worship God, and must build temples, if not for His glory, at least for their own comfort, and in ministering to these requirements, this practice of pinning to a building appropriated to either of the above uses, some of the embellishments of another building, held as classic precedent, producing excrescences which architects seem to think are the only things about the structure which have any right to the name of architecture, is, in fact, the great hindrance to the natural growth of architecture. It is *this* practice which is the degeneracy of modern architecture.

Is it to be supposed that Grecian architecture would ever have grown to what it is, if the architects of that land had not given free room for the genius of their country, and its institutions, to manifest itself architecturally? Imagine *them* believing that the Egyptian was the only correct architecture, and insisting on sloping the sides of their buildings, placing their columns within the walls, and hiding their sloping roofs, necessary for the climate, behind an immense horizontal entablature. What a monster would have frowned from the heights of the Acropolis, instead of the ever living edifice that stood there glowing with the life, the youth, the poetry of Greece.

Why was it that the Romans never attained to an original style of architecture, although they had, to begin with, that emblem of strength and beauty, the arch, as an elemental national feature? Simply because they believed that the Greek was the only architecture in the world. They therefore modestly used the arch as a constructive element, and imprisoned it within an external Greek façade, binding the free curve of their own glorious arch under the dominion of column and entablature. This was to put the full blooded Arabian courser into the harness of Juno's peacocks, and then wonder to see the goddess upset, the harness broken, and the chariot shivered.

Thus it was that the arch, with the Romans, never gave birth, as it should have done, to a national style, and yet we see how, in different hands, out of that same arch and its wonderful capabilities, the Norman style was formed, and thence by true artistic treatment, managing this same arch with the buttress, it became the most yielding thing in art-creation, the graceful, the flexible Gothic, coming out of it "as sweetness out of strength," honey indeed "out of the jaws of the lion."

And yet the degeneracy of architecture is now loudly talked of,

and no one sees at the present day *how* any thing new is ever to be done in that art, except by adherence to the rules, not according to which any greatness in architecture was ever achieved, but according to which you may copy any given production of the art.

According to these same critics, it would be easy to show that modern architecture is not by any means degenerate, if their own rules of perfection are at all good for any thing. Is the Parthenon good architecture? What hinders us from building a Parthenon? The money being given, we could re-produce that, or any other building that has been be-measured as the Parthenon has been. Is York-minster good architecture? Then the front of the new national Scotch church, in London, is assuredly good architecture enough to content one, for it is as near a fac-similie of the west front of York cathedral as modern means will allow. Indeed, do we not possess already a modern specimen of every conceivable style that has existed in any quarter of the globe? Surely then, according to such views, our architecture is not degenerate. But has this endless repetition of the architecture of the past, any title to be called the architecture of the present? is this the way to produce any thing new, or good, or great, in architecture, any thing bearing on it the impress of the characteristics of this generation, any thing homogeneous with the advanced state of civilization?

Truly, indeed, modern architecture is degenerate, is utterly dead, we should say, in view of what we have just shown, (for if there is any modern architecture at all, what, and where is it?) did we not possess a cheerful faith, which is ever telling us that architecture is too intimately connected with man to perish while there is a man upon the earth. Must *man* progress in goodness and in wisdom? then must *architecture* also! Is man so progressing? then is architecture also, though we may not know it nor see it. Architecture must manifest the changes that are taking place in society, the greater ones, we hope and believe, that are yet to come.

It is as much out of the rule of rationality to think it possible to re-invigorate architecture by forcing it into any antique mould, as to expect that, if disgusted with manhood, we can bring back simplicity and innocence by putting on again the garments of youth. Architecture must grow naturally, its own peculiar tendencies must be observed, and it must be trained accordingly. How is this to be done? let us all try to find out, let us all try and see which of us will first produce something in the art peculiar—characteristic—suited to the age—national.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1840.
With Remarks and Exemplifications by the Editor.

1. For constructing *Truss Frames, principally intended for Bridges;* William Howe, Warren, Worcester county, Massachusetts, August 3.

This bridge is, in many respects, similar to that patented by the same person on the 10th of July last, and noticed in our last number, but instead of wedges, screws are used for cambering the bridge, and instead of posts, extending from the lower to the upper string piece, iron bolts, with a screw and nut at the top, are employed. The first set of braces and counter braces, start from the top and bottom of the first bolt, pass by the second, and abut against the top and bottom of the third—the second set commence from the second bolt, pass the third, and abut against the fourth, and so on to the end of the bridge. The screw bolts pass through wedge pieces of wood, at top and bottom, and the ends of the braces and counter-braces, abut against them, instead of against the screw bolts. By this arrangement it will be seen that as the upper and lower strings may be brought nearer together by screwing the nuts on the ends of the screw bolts, and that the action of the braces and counter-braces will thereby camber the truss.

Claim.—"What I claim as constituting my invention in the above described truss frame, and which I desire to secure by letters patent, is the manner in which I have combined the iron bolts, and the wedge pieces, against which the braces and counter-braces abut, so as to co-operate in increasing the camber to any desired extent, the whole truss frame being constructed, and acting substantially, as herein set forth."

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2. For a machine for *Cleaning Grain;* Amos Adams, Port Henry, Essex county, New York, August 3.

This machine is, in its general construction, old; its novelty consists simply in covering a revolving cylindrical screw, which works on a fixed horizontal axis placed at the top of the conical beater, with wire gauze, the meshes of which are of different sizes. That end of it in which the grain is fed, is covered with wire gauze of such fineness as not to allow the grain to pass through, but to permit the escape of the dust, and the remainder is covered with gauze of larger meshes, so as to permit the escape of the grain, but not of substances which are larger than the grain, these creeping through the open end of the screen. The patentee also combines such a screw with a revolving vertical beater and case, in which the grain is to be beaten and cleaned. The grain is fed in from the revolving screen, between the revolving beaters and the outer case, by means of a hopper.

The claim is to the "manner of constructing the revolving feeding screen, and of combining it with the body of the instrument in which the beating and agitation of the grain are effected, as herein set forth."

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3. For a *Machine for Throwing Balls and other Bodies;* Joseph Martin, Louisville, Kentucky, August 3.

This patent is for improvements on a machine for throwing balls by "centrifugal and projectile forces," patented by Robert M'Carty, of New York, on the 31st of December, 1838, and noticed at page 380 of the 24th volume, second series, of this Journal; the objections there made by us we deem equally applicable to the plan under consideration.

We omit the claims, as they refer, throughout, to the drawings, and could not be understood without them.

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4. For a *Mill for Breaking and Grinding Bark;* Richard Montgomery, and Lewis W. Harris, Sargerfied, Oneida county, New York, August 12.

This mill purports to be an improvement on that kind of bark grinder and breaker, in which a nut and case are used, similar to those of the common coffee-mill; and it consists simply in attaching to these, by means of arms, one, or more, concentric nuts, or grinders, and cases. The second and third, &c. nut, or grinder, have teeth on the inside as well as outside, and the inside teeth of the second grinder act against teeth on the outside of the case of the first, or central, nut, and the outside teeth act against teeth on the inside of the second case. The nuts, or grinders, are united by arms at the bottom, and the cases by arms, or braces, at the top, between which the bark, &c., is fed.

The claim is to the "combination of the conical nuts, two, or more, with the cylinders (cases,) placed concentrically."

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5. For an improved mode of constructing the *Packing for Pistons, &c. of Steam Engines;* Charles F. Pike, Providence, Rhode Island, August 12.

(See specification.)

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6. For a machine for *Beveling Boot Forms;* Elijah Holmes, Stoughton, Norfolk county, Massachusetts, August 12.

The boot form is attached to a frame placed upon a suitable bench, provided with guide grooves, into which pins, projecting from the bottom of the frame, fit, to guide the boot form, so as to receive the proper shape when presented to a double cutter wheel, which revolves horizontally. This cutter wheel is provided with a deep groove, and has one set of cutters attached to the upper, and one to the lower part, facing each other, each set forming one-half of the bevel of any desired form.

Claim.—"Having thus described my machinery, I shall claim re-

ducing, or beveling, the edges of boot forms, in the manner herein above explained, by revolving cutters, in combination with a frame for holding the boot form, the said frame having projecting pins, or guides, traveling in grooves, for the purpose of presenting the form in a proper manner to the action of the cutters, the whole being arranged, and operating substantially, in the manner herein above set forth."

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7. For a machine for *Cutting the Teeth of Circular Saws;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, August 12.

The teeth are to be cut by means of a punch worked by a lever, in the usual manner. The saw plate is attached to a circular plate, on the upper end of a vertical spindle, which receives an intermitting rotary motion, so that whilst the punch is cutting off a tooth the spindle is at rest; and when the punch is lifted up clear of the saw plate the spindle is moved around the space of one tooth, its motion being again arrested. This is effected in the following manner. On the spindle there are two toothed wheels, one above the other; the teeth of one are made in the usual manner, and on the other they are slightly inclined with the axis of the spindle. These wheels are acted upon alternately by two horizontal shafts, which receive their motion from the crank shaft, which operates the punch. That which engages with the wheel having inclined cogs, carries a segment of an endless screw; and the other has a grooved piece, and they are so arranged that just as one is disengaged the other commences its action; that with the screw actuates the spindle, and the other keeps it at rest. The size of the teeth to be cut will be regulated by the diameter of the intended saw, and the inclination of the threads of the screw.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the machine above described, consisting in a combination of the said several parts, for giving a regularly intermitted motion to the circular saw plate, and for holding the same still and steady in the intervals of motion, and of the parts for cutting the teeth."

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8. For a machine for *Filing the Teeth of Saws;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, August 12.

The patentee says, "My invention consists in causing the saws, which are to be filed, or smoothed, to pass with a regular intermittent motion of the distance of one tooth under a file, to which a movement is given corresponding with the motion of the saw plate, and the form of the tooth to be filed, and the whole so combined and arranged into parts, that during the time in which the file is acting upon the teeth the plate is holden steadily, and without motion, until the file has performed its office, at the same time giving to the file a peculiar compound motion, which may be varied, so as to be accommodated to the perfect filing of any saw tooth." The motion is given to the saw plate in a manner similar to that of the machine for cutting saw teeth, above noticed. The files used are straight, two being used, one on each side, and crossing each other at any desired angle.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the machine above described, consisting in a combination of the said several parts for giving a regularly intermitted motion to the same plate, and for holding the same still and steady in the interval of motion, and of the parts for filing the teeth."

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9. For an improvement in the *Machine for Sawing Stuff Circular;* Thomas Kenderdine, Jr., Harsam township, Montgomery county, Pennsylvania, August 12.

A saw is to be strained in a frame similarly to those employed by cabinet makers for sawing curves. This frame works on an iron guide rod, permanently attached to standards, and passes through holes made in plates that slide in slots made in the end pieces of the saw frame, so that the saw may be set nearer to, or farther from, the rod on which the frame works. The wood to be sawed is fixed in a clamp attached to a frame, provided with the necessary carriages, &c. The claim is confined to the "use of the guide rod passing through the sides of the saw frame, which is to be made adjustable, so as to adapt it to different curves, as described."

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10. For an improvement in the *Screw Wrench;* Stephen Keane, Thomas Keane, and James Keane, City of New York, August 12.

The movable jaw of this wrench is actuated by means of a screw revolving on a stem attached to the back of said jaw, the threads of which take into worm teeth cut in the edge of the wrench handle.

The claim is confined to the manner of "constructing the movable jaw by combining therewith a revolving screw, whose threads work into worm teeth cut into the edge of the wrench handle."

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11. For a machine for *Sawing and Splitting Timber;* John P. M'Dowell, Summit, Cambria county, Pennsylvania, August 12.

In this machine two circular saws are used, one at each end of a frame, which is hung on an axis, so that either saw can be brought down against the wood to be sawed, whilst the other is elevated, and relieved from the piece which has been cut. The saws are driven by a band passing around a whirl on each saw shaft, and receiving motion from the main shaft, which forms the axis of vibration of the frame. Each end of the main frame of the machine is adapted to receive a log, and is provided with the necessary fixtures for holding it during the operation of sawing, and for gauging the length of the piece to be sawed, which, after being cut off, runs down an inclined plane to a place in the middle of the frame, where it is split by being forced against a set of cutters, by means of a follower.

The claim is confined to the "combination and arrangement of machinery for sawing, with the machinery for splitting logs and other materials."

12. For an *Alarm Lock for Doors;* David Edwards, M'Connelsville, Morgan county, Ohio, August 12.

This patent was granted for the combination of an alarm with a door lock, and for a peculiar arrangement of an escapement, which operates the striker of the alarm bell. The bell, and the machinery which operates the hammer, are placed within the frame, or case, of the lock, and are so arranged that, when set, any attempt to push back the bolt actuates the alarm. We omit the claim, as it refers, throughout, to the drawings.

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13. For a *Machine for Boring and Mortising Chairs, &c.;* William L. Harley, Chagrin Falls, Cuyahoga county, Ohio, August 14.

The first item claimed is, "the construction of the bit, with cutters on the end, and teeth in the sides, in combination with the twist." This bit is formed like the single twist auger, with a cutting lip at the end, cutting edges running the whole length, so as to bore out mortises, by giving to the piece of wood to be mortised a reciprocating movement.

The second item claimed, is the "combination of the two carriages, the lower one resting upon a stationary frame, and moved in it lengthwise by a lever, to give depth to the holes and mortises to be bored, and the upper one moved transversely by a crank, to give length to the mortises." This part of the claim needs no explanation. The third item of claim is to the "construction of the frame for the seats to rest on, so as to be presented obliquely to the bit, in combination with the lower carriage. And the last item is to the "construction of the frame for the legs to rest on, to be presented obliquely to the bit, in combination with the lower carriage." The constructions claimed under the two last sections of the claim can be imagined by mechanics more readily than they can be explained without drawings. These frames are provided with joints and slides, so as to present the part in any desired position. The bit is put in the mandrel of a lathe, and the machine presented to it with any part of a chair which is to be bored or mortised.

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14. For an improvement in the *Rotary Fan Blower for Forges and Furnaces;* James Stewart, Springfield, Robertson county, Tennessee, August 17. Antedated July 1st, 1840.

This improvement consists simply in using two, or more, fan wheels on the same shaft, each contained in a separate chamber; the current generated by the first wheel is received into the second chamber, and passes through the second, third, and so on, if more than two are used. Claim.—"Having thus fully described the nature of my blowing machine, and shown the manner in which the same is carried into operation, what I claim therein as constituting my invention, and desire to secure by letters patent, is the placing of two, or more, fan wheels upon the same shaft, but within separate compartments, combined and connected with each other in the manner herein set forth."

We have seen this machine in operation in blowing a smith's forge, and its action was such as to bespeak real utility; we have not, however, heard of its adoption by mechanics, and suppose, therefore, that it has not redeemed its promise.

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15. For a *Smut Machine for Cleaning Grain;* John Burch, Millport, Chemung county, New York, August 17.

This machine has a cylinder, formed of wove wire, or perforated sheet metal, with triangular ribs, running its whole length within the wire. This cylinder revolves slowly on a horizontal, or nearly horizontal, shaft, whilst the shaft revolves with great rapidity, and carries suitable beaters. The slow revolution of the cylinder furnished with ribs carries up the grain which is discharged upon the beaters. Motion is given to the cylinder and beaters by well known means, which need not, therefore, be described. The claim is confined to the "revolving of the revolving cylinder, with its perforated surface and triangular ribs, with the revolving beaters placed on a shaft in the axis of said cylinder, so as to constitute a grain cleaning, or smut machine, constructed and operating substantially in all respects, in the manner herein set forth."

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16. For an improvement in the *Railway Track, for Turning Short Curves;* Henry M. Naglee, City of Philadelphia, August 17.

(For specification see vol. 27th, p. 171, 2nd series.)

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17. For improvements in the *Dredging Machine*, for deepening Harbours, Rivers, Canals, &c.; William Easby, City of Washington, D. C., August 25.

This machine is intended to be worked by horses, that travel on a circular platform, built on the deck of a large scow. The whole machine is made narrow enough to pass through a canal lock, and in order to make the platform, on which the horses travel, of sufficient size, a segment of the circle, called a wing, is hinged on each side to the scow, so that in passing through a canal lock, or any other narrow place, the wings may be turned up. The scoop is to be worked by two barrels, or drums, placed one at the top, and the other at the bottom, of a vertical shaft, in the middle of the platform—these drums are, alternately, thrown in and out of gear by means of a vertical sliding bolt, and a horizontal lever, worked by the attendant. The chain that draws up the scoop passes around a roller at the end of the machine, and thence around the barrel at the top of the shaft, and that which draws it down and back, passes under the platform, and winds on the lower barrel.

The scoop is attached by one of its sides to two long guide poles, that slide in loops made in two collars, turning loosely on the ends of a horizontal windlass, which forms the axis around which the scoop swings, when drawn up or let down. In letting down the scoop, the chain which is attached to its bottom, is drawn in by throw-

ing the lower barrel into gear; this causes the guide poles of the scoop to slide in the loops, which brings it near to the windlass, and after it has passed a vertical line its gravity causes it to sink. The lower barrel is then thrown out of, and the upper into, gear; by this the scoop is drawn along the bottom, and filled, and then, with its load, is drawn up out of water. The stuff raised is discharged from it into a scow, or other receptacle, by pulling a rope, or chain, which disengages a spring catch, by which the hinged bottom is fastened. The bottom is closed as the scoop strikes the water, in the operation of being drawn down to be re-filled. The distance to which the scoop descends below the windlass, around which it works, is regulated by a chain, which winds around it, and is attached to a brace connecting the two guide poles together, near the scoop.

Claim—"What I claim as my invention, and desire to secure by letters patent, consists in the arrangement of the barrels on the perpendicular shaft, for winding and unwinding the main chains, in combination with the vertical sliding bolt and lever, for throwing the barrels in, and out of, gear, with the shaft, by which the scoop, or bucket, is alternately raised, lowered, and drawn back, whilst the animal, by which the main shaft is turned, continues to travel on the circular tracks without interruption." Also the combination and arrangement of the parallel guide poles, chains, and windlass, for raising the scoop, so as to draw it back to its proper position, as described;" and this I also claim in combination with the scoop and the apparatus for "disengaging the drop, or shutter, to discharge the load, as described." I also claim "the arrangement of the wings of the horse track, which can be raised, and thereby reduce the width of the machine, so that it may pass through a canal lock, or any other narrow place, as described."

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18. For *Conducting Grain and Straw after it has been Thrashed;* Luther Whitman, Winthrop, Kennebeck county, Maine, August 25.

The general principle of this machine does not present any thing new, and the claim has, therefore, been confined to the peculiar arrangement of the parts. Slats of wood are attached, edgewise, to two chains, which pass around two rollers. The belt, or chain, of slats thus formed, slides on an inclined board, so that the slats form the sides, and the inclined board the bottom, of a series of cells. One of the rollers around which this belt works, is placed under the thrashing cylinder, and the other roller is placed near the elevated end of the inclined board, at the back part of the machine. As the straw and grain are thrown out by the thrasher, the former falls on the top of the slats, and the latter passes into cells formed by the slats, and by the inclined board, on which they are sustained, and the straw and grain are thus carried up, and the former is discharged on to another belt of slats, called the carrier, which conveys it off to a distance, while the grain falls on a board, which conducts it to the fanning machine.

Claim.—"What I claim as my improvement, and for which I ask

an exclusive right, is the combination of the endless belt of slats, constructed as herein described, with the inclined board and straw carrier, the whole being so arranged that the belt, while it conveys the straw from the thrasher, carries the grain also with it up the inclined plane, in the manner described."

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19. For improvements in the *Machine for Planting Corn and other Seeds;* Samuel W. Cole, Chelsea, Suffolk county, Massachusetts, August 25.

This machine is a modification of that kind of seed planter in which the seeds are taken from the hopper and carried around to a dropping tube, by a wheel, with cavities made in its periphery; the improvement consists simply in making the cavities in separate pieces, which fit into receptacles made for that purpose, in the wheel, so that pieces with different sized cavities may be employed at pleasure for different kinds of seed.

The claim is, first to "constructing the dropping cylinder with changeable slides, and forming receptacles in the same for receiving the seed from the hopper; also the mode of adapting the lower part of the hopper to the apertures in the end of the slides, by forming it with chutes, in the manner set forth, so as to better conduct the seed to the receptacles in the slides, the whole being arranged, and operating substantially, as above described." Second, I claim the mode of compressing, or regulating, the "stiffness of the brush (which makes a part of the hopper,) by means of the clamp and screw, in combination with the hopper and dropping cylinder."

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20. For a *Cooking Stove;* Samuel W. Cole, Chelsea, Suffolk county, Massachusetts, August 25.

This stove is circular—the fire-chamber, which is conical, and provided with a grate at the bottom, is placed in the centre, thus leaving a baking-chamber all around. The fuel is fed in at the top, through an opening in an elevated cap, which opening may be closed by a boiler, or by a cover. The pipe which leads to the chimney passes out from the cap.

The fire-chamber is surrounded by a cylindrical tube, which extends from the lower part nearly to the top of the baking-chamber—at the top it is in contact with the fire-chamber, and as one of these is conical, and the other cylindrical, there will be a space between the two, reaching from the part where they touch, to the bottom; the object of this arrangement is fully explained in the claim. The cylindrical tube is surrounded by a circular perforated shelf, supported on screw rods, which pass through the bottom plate, to regulate the height of the shelf.

Claim.—" I claim the particular mode of adapting the circular shelf to the oven, and adjusting the same by means of screws passing through the bottom plate, also the furnace constructed with an exterior casing, or cylinder, for the purpose of causing the heat radiating from the outer surface of the furnace to pass downwards, and escape

near the bottom of the oven, thereby causing it to be first distributed under the rising shelf, at whatever height the same may be in the oven, the whole being arranged and operating substantially, in the manner, and for the purpose above described." I claim the combination of "the circular shelf with the oven and furnace, the furnace being so arranged in the oven that the shelf shall entirely surround it."

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21. For a *Machine for Planting and Sowing Seeds;* Joseph Gibbons, Adrian, Lenawee county, Michigan, August 25.

The hopper of this machine is made of any desired length to correspond with the number of rows intended to be planted at the same time, and is divided into sections by partitions running across it, each division having a corresponding dropping tube. Below the hopper the machine is crossed by a roller provided with cavities, to receive and carry around the seeds, or plaster; the capacity of these is regulated by a tube of tin, or other metal, that surrounds the roller, and may be made to revolve thereon to a small distance; this tube is provided with apertures, which correspond with the cavities in the roller, and one edge of the metal forming each aperture is turned down into the corresponding cavity in the roller, and reaches to the bottom of it, so that by turning one on the other the capacity of the cavities may be enlarged, or diminished; a roller runs across the machine at the rear part of it, by which roller the rows are to be covered; and when it is desired to stop the seed roller the operator bears upon the handle at the back, which lifts the wheels that operate it from the ground.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I regulate the capacity of the cavities made for receiving and carrying the seed to be planted, or sown, by surrounding the roller in which said cavities are made, by a tubular casing, adapted thereto in the manner described." "I also claim the manner of constructing and using said machine, so that by bearing upon the handle, or handles, at the back part thereof, the roller will operate as a fulcrum, and the distribution of the seed will be arrested."

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22. For a *Card Printing Press;* Samuel Orcutt, Boston, Massachusetts, August 25.

The following is the claim upon which this patent was granted, viz. "What I claim as constituting my improvements, and desire to secure by letters patent, is first, the manner in which I have connected and combined the lever and toggle with the frisket, the inking drum and inking rollers, so that by the depression and elevation of said levers, the frisket shall be carried under the platten, the inking apparatus being brought into operation, and the frisket moved out after the impression has been made, all as herein set forth." Secondly, I claim the general arrangement "of the respective parts of the frisket for holding the card, in combination with apparatus for dropping the card, by withdrawing the parts upon which it is supported, by means

of the angular catches, or triggers, and their appendages. The other parts described I do not claim; as many, if not all of them, have been previously used in other forms."

We could not, within the limits allotted to a single notice, make the character of these improvements more clear than is done in the above claim, without giving drawings, by which the patent is accompanied.

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23. For *Puddling Furnaces for Manufacturing Iron;* Thomas Cooper, City of New York, August 25.

The patentee says—"The nature of my invention consists in providing a reverberatory furnace with a hearth, space, or dead work, around the grate, or fire-bars, by which the brick work of the fire-chamber is protected from intense heat, and from which the clinker is easily removed. With a vertically descending flue when applied to puddling, scrapping, bitteting, or heating iron with anthracite coal; and in the combination of two, or more, heating bottoms and fire-chambers in one furnace." The grate is made in the middle of the chamber of combustion, or the receptacle for the coal, with dead brick work all around, on which the coal, not fully ignited, rests, and the flue on the side of the heating, or puddling chamber, opposite the chamber of combustion, descends, and then passes out, horizontally, to the chimney. The descending flue, when two heating chambers are employed, is used for the draft of the two chambers of combustion.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the floor, or bottom of the fire-chamber, with a grate in the centre, as set forth, surrounded by a dead work for protecting the brick work of the chamber, as described." "Also constructing the furnace with a vertical descending flue, in the manner, and for the purpose set forth." "Lastly, I claim combining two, or more, furnaces, constructed with grates and dead work, and having a descending flue, all as described."

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24. For an improvement in the *Franklin Cooking Stove;* Reuben B. Houghton, Clarkson, Monroe county, New York, August 25.

The back plate of the fire-place in this stove, instead of running up, as usual, rises only a few inches, and just above the upper edge of it a square shaft extends from side to side of the stove, and passing through one of the side plates is provided with a winch by which to turn it round—from one of the sides of this shaft grate bars project, and from a contiguous side, a flat plate extends at right angles to the grate bars. Between the back plate of the fire-place and the front plate of the oven, there is another plate, extending nearly as high as the top of the oven, with a flue between it and the oven; and the side plate of the stove is provided with an opening, and door to correspond to the space between it and the back plate. By this arrangement the fire may be situated nearer to, or further from, the oven. When the shaft is so turned as that the grate bars lie horizontally, the fire is sustained on the grate, and the dead plate stands at right angles

thereto, and forms the back of the fire-place; and when it is turned, so as to have the grate bars vertical, the plate lies horizontally, and it, together with the grate and the second back plate, constitute a box stove, which is supplied with fuel through the door at the side. Two valves are used to regulate and give proper direction to the draft. The claim is limited to the combination of the "turning grate" with the vertical plate and dampers.

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25. For an *Electro-Magnetic Machine* to obtain a Moving Force for driving Machinery; Truman Cook, New York City, August 25.

The following extract from the specification will give a pretty accurate idea of the invention. "Having thus fully described the manner in which I construct my electro-magnet apparatus, and likewise the manner of making the improved galvanic trough for actuating the same, what I claim therein as constituting my invention, and desire to secure by letters patent, is first, the arranging of the armatures upon a cylinder, or drum, in combination with the pairs of electro-magnets so situated as that the negative and positive pole of each individual magnet shall, at the same moment, be over two contiguous armatures, in the manner herein set forth." "Secondly, I claim the mode of interrupting the galvanic circuit by means of the cams, or notches, on the axis of the cylinder operating the wires which dip into the cups of mercury, as set forth, in combination with the stationary magnets and revolving armatures, arranged and constructed as herein described." "Lastly, I claim the galvanic battery herein described, composed of separate and distinct plates, communicating with cups of mercury, in the manner described, in combination with the electro-magnetic apparatus, consisting of stationary magnets and revolving armatures, as described."

At the period when this patent was obtained, a machine of considerable size had been built, for the purpose of driving the propelling apparatus of a boat; not having heard of the result of the experiment, we are compelled to infer that there is one more to be added to the list of unsuccessful attempts in the employment of the electro-magnetic power as a substitute for steam.

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26. For improvements in the *Machine for Carding, or Picking, Curled Hair;* Francis Harding, Cleveland, Cayuhoga county, Ohio, August 25.

Upon a cylinder about two feet in diameter, and similar to the cylinder of a carding machine, slats are attached, which are about two inches in width, and four inches apart—these slats are covered with cards having two or three rows of strong wire teeth set in stout leather, and bent, or hooked, forward. Over the cylinder, attached to arch pieces, are six stationary slats, provided with teeth similar to those on the cylinder, but with the hooks turned the reversed way. These slats are connected with the arch pieces by means of springs, so as to give them some play; the teeth on these slats are of the same kind as those on the cylinder, but they are less and less coarse as they recede

from the feed apron and approach a brush cylinder, which is opposite a feed apron, by which the machine is supplied.

The claim is to the combination of the stationary and revolving cards, arranged, constructed, and operating as described, and in combination therewith the revolving cylinder of brushes, each brush consisting of a single row of bristles.

The difference between this machine and the carding, or heckling, machines, previously in use, will be manifest from the fact that neither of these machines would perform the operation of picking curled hair; whatever similarity there may be between them, it must be plain that they are by no means identical.

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27. For an improvement in *Chairs;* Matthew W. Ring, New York City, August 25.

The seat of this chair is jointed to a bottom plate so as to rock on it, and the rocking is relieved by spiral springs placed between the seat and plate, towards the front and back edges thereof. The covering around the edges, which unite the rocking to the permanent part of the bottom, is put on so as to give full play to the seat. The bottom plate is connected to the pedestal by a pivot, similar to that used in the stools of piano fortes; and the back and arms are formed of metallic rods, bent in the proper shape, to render them easy and flexible.

Claim.—"I do not claim to have invented the before described separate parts of the revolving accommodating seat, but what I do claim as my invention, and wish to secure by letters patent, is the combination of the revolving with the jointed spring seat, as before described." "I also claim the mode of making the spring back and arms, by means of metallic spring bars, or rods, as described."

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28. For a *Cotton Press;* Fowler M. Ray, Catskill, Greene county, New York, August 25.

In this press the follower is forced upwards, and this is effected by the aid of two ropes, or chains, one attached to each end of the follower, and passing thence over a pulley, and having its outer end attached to an arm projecting from a shaft, at right angles thereto. A snail, or fusee, wheel is attached to one end of the shaft, and from this a rope passes to a capstan. When the follower of the press is down, the arms to which the ropes are attached, are horizontal, and the rope from the capstan acts upon the smallest part of the snail wheel, hence the motion of the follower will be rapid, the resistance to its upward motion being at that time small; but as the resistance increases the power of the levers, formed by the arms, gradually increase until the rope winds upon the shaft from which they proceed, and at the same time the snail wheel is also lengthening its purchase, so that at the time the follower meets with its greatest resistance the power applied has also reached its highest point.

This arrangement constitutes a very simple and efficient mode of applying a progressively increasing power to a press.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the using of the arms, projecting at right angles from the shaft, and having ropes, or chains, attached to them, which pass over pulleys, and raise the follower of the press; the respective parts being combined, connected, and operating substantially as herein set forth." "I do not claim the manner of constructing and applying the capstan and windlass to my press, although I believe that there is novelty in their mode of construction and operation; nor do I claim any of the other parts described, when taken alone, but I limit my claim, as above, to what I consider to be the distinguishing feature of my press; and this part, or arrangement of parts, I claim, whether constructed precisely in the form and manner described, or in any other which is substantially the same."

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29. For a *Mill for Grinding Apples, or other Fruit;* Thomas J. Wells, New York City, August 25.

The crushing, or grinding, is effected by two disks, whose surfaces are very flat cones, each of them attached to the end of a shaft, and the axes of the shafts are placed at an angle to each other, equal to the angle formed by the cone with its base, so that when the two disks are brought together, one side of the cone of one disk will touch, or nearly touch, one side of the opposite disk, whilst the other portions of their surfaces will be separated. The shaft of one of the disks slides in its bearings, and is pressed up to the other by a weighted lever. A hopper is so placed as to feed the apples, &c., between that part of the disks which are separated.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode above described, of crushing apples, or other fruit, by the action and combination of the two conical disks combined with the lever and pulley."

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30. For an improved *Elevated Oven for Cooking Stoves;* J. P. Williston, and Willard A. Arnold, Northampton, Hampshire county, Massachusetts, August 25.

The following extracts from the specification will be found to give a very clear idea of the improvement. "In elevated ovens heretofore constructed, the body of the oven has been formed of two cylinders of unequal diameter, one of which is placed within the other, at an equal distance, both at the bottom and sides, from the outside cylinder, thus constituting a flue, into which the heated air and smoke are allowed to enter at the bottom, through two, or more, pipes, and to escape from the top through a pipe leading into the chimney."

"It has been found, by experience, that with an oven so constructed, a much larger fire is required to bake in the oven, than is necessary for doing the ordinary work of the stove to which it is attached."

"This objection to elevated ovens we have obviated, by enlarging at the bottom the space between the interior and exterior cases, of which the oven is formed, and narrowing it upon its sides and top."

"What we claim, is the enlarging of the capacity of the flue which

surrounds the oven, at its lower side, and diminishing it on its sides and top, in the manner, and for the purpose described."

31. For a *Process for Tanning Leather;* Abel H. Buzzell, Bridgeton, Cumberland county, Maine, August 25.

The patentee says—"The nature of my invention consists in raising the hide by the aid of sulphuric acid, (oil of vitriol of the shops,) and when raised sufficiently, so changing the same with tannin that it will not return to its original condition. Then suspending wood ashes, contained in sacks, in the pits, to destroy the compound which is formed by the tannin and sulphuric acid, and which prevents the gelatin of the hide from uniting with the tannin. This method renders the use of the acid, to any desirable or necessary extent, perfectly safe; shortening the period for tanning, and increasing (by means of the acid,) the capacity of the hide for receiving tannin, and adding much to the quality of the leather."

"What I claim in the above process as my invention, and desire to secure by letters patent, is the mode of tanning hides, by placing them, when raised, in a decoction, or solution, of bark, or other liquor containing tannin, and after they have remained there a suitable time, as herein specified, adding an alkali to the liquor, as herein set forth."

32. For an improvement in the *Lamp for Burning Camphine;* Michael B. Dyott, City of Philadelphia, August 25.

This improvement is described as applied to that kind of lamp formed by the union of two cones, with three inclined burners projecting therefrom. The improvement consists of a plate which rests upon three, or more, screws, by which its height is regulated; this plate is perforated with three holes, through which the upper part of the wicks and flame pass, and as they are larger than the burner, they admit the necessary and desired supply of air, which supply may be regulated at pleasure, by turning the screws on which the plate rests.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is not any exact proportion, or number of burners, or the particular mode of disposing, or placing, them in any peculiar form, or situation; but I claim the mode described, of regulating the draught by means of a movable plate, which sustains the glass chimney, and otherwise being constructed and operating as set forth, and described in the above specification."

33. For an apparatus for *Obtaining Casts from the Teeth and Gums, and for Adjusting the Casts when taken;* Daniel T. Evans, City of Philadelphia, August 28.

The patentee says—"This apparatus consists in an improved mouth mould, which is to be filled with wax, that a perfect impression of the teeth and gums may be taken by allowing the jaws to close upon it; after which, the impression so made, is to be filled with plaster of paris, and this, whilst in a soft state, is to be placed between plates of

metal, in an instrument made to open and close in the manner of the mouth; a portion of the plaster being placed upon said metallic plates, for the purpose of attaching the two portions of the cast thereto."

"I claim as my invention—First, the manner of constructing the mouth mould without a dividing plate, so as to admit of the meeting of the teeth, and of their lapping over each other in taking the impression, as set forth." "Secondly, I claim the manner of constructing and combining the apparatus of plates for receiving and holding the casts, in plaster from the teeth and gums; said apparatus being furnished with a movable plate, the action of which is similar to that of the lower jaw in the living subject."

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34. For an improved *Process for Manufacturing White Lead;* Smith Gardiner, New York, August 28.

(See specification, p. 123, vol. 26, 2nd series.)

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35. For a machine for *Hulling Rice;* Warren Groat, Troy, Rensselaer county, New York, August 28.

The patentee says—"The nature of my improvement consists principally in the construction and application of machinery by which the grain is made to pass between the surface of one body in motion and another at rest, or both in motion at different velocities, or in contrary directions. The one being hard and rough, and the other, yielding and elastic, so that under the regulated pressure for which provision is made, as will be shown in the description, their co-operation will give to the grain the action required, and at the same time allow it to pass without being unnecessarily broken by the process."

"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing a cylindrical surface of files, or of stone, and a yielding and elastic surface, or bed, made by the union of caoutchouc and leather, and employing the said cylinder and bed in connexion, or co-operation with each other, in the manner, and for the purpose above described. And also the placing of files at discretion, between different sections of such elastic bed, and using the same in like connexion with the cylinder, for like purposes, as also above described."

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36. For a *Steam Boiler and Generator;* Dudley Marvin and Oran W. Seely, the former of the city of New York, and the latter of Sodus, Wayne county, New York, August 28.

This patent is obtained for a boiler for generating steam for the purpose of steaming and cooking articles of various kinds. The sides and back end which surround the fire chamber are double, and contain water, and the part of the boiler which is over the fire chamber, consists of water cells, which run from front to back, leaving spaces between for the circulation of the draught of heated air. Division pieces running horizontally from the front nearly to the back, divide the spaces between the cells into two compartments or flues. The

heat impinges on the bottom and sides of the cells, and circulates around the ends of the division pieces, along over them, and out at the chimney flue, which is in front, above the feeding door. The steam is carried off by pipes from the steam chamber to any place desired. The whole boiler is composed of seven parts, so formed as that they may each be moulded and cast in one piece, without the use of cores.

Claim.—"We claim first, the manner in which we have constructed and combined the respective parts of our boiler, or steam generator, with each other, as described; that is to say, we claim the formation of the water cells, consisting of one which surrounds the three sides of what we have denominated the principal casting, extending down to the lower edge of said casting, and having three, or any preferred number of water cells, intermediate between the cells at the sides of the principal casting, said intermediate cells extending down so far as to leave the requisite space for the fire chamber, and having spaces between them, which are to be converted into reverberating flues, by means of partition or division pieces, located and operating in the manner herein set forth. We claim, secondly, the forming or making of that part which we have denominated the principal casting, in one single piece of cast iron, by giving to the respective parts thereof, the designated taper, and otherwise constructing the pattern, in the way described, so that it will draw from the mould, and may be cast in a single pair of flasks, without the employment of cores."

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37. For a *Machine for tarring Shivers or Bands of Hemp, and making Oakum of the same;* William Montgomery, Boston, Massachusetts, August 28.

The patentee says—"The object of my invention is to prepare oakum from the Cordilla hemp or tow (sometimes so called) which is of much poorer quality than the Russian hemp; and inasmuch as the fibres of the former are shorter than those of the latter, though equally sound and new, and sufficiently good, for the above mentioned purpose, as it produces a better quality of oakum than that obtained in the manner now practiced from the tarred rope and yarns. Another object of my invention, is to prepare the oakum in a proper roving, or shiver, so that without any further preparation, than that of being properly dried after passing through the operation of my machinery, it can be applied to its purpose of caulking the seams of vessels, &c."

The shiver of hemp is passed between two rollers, and around a reel which revolves in tar, and is provided with radial arms and guides, by which the shivers on the reel are pushed towards one side to make room for the shiver, which is constantly rolling on. After the shivers are taken from the reel, they are passed between two sets of rollers, the first of which press out the surplus tar, and the others being draw-rollers, separate and draw out the fibres, and supersede the necessity of picking. There are weighted, curved guides and rods, which prevent the tar from gathering in lumps, as the shivers

pass through the pressing rollers. We omit the claim, as it refers throughout to the drawings.

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38. For *Heating the Blast of Smelting Furnaces;* William H. Phillips, Brooklyn, New York, August 28.
(See specification.)

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39. For a *Composition for rendering Leather Water-proof;* Charles F. Miller, city of Baltimore, Maryland, August 28.

The ingredients which form this compound, consist of one part of beeswax, one part of spermaceti, one part of rosin, half a part of suet, half a part of hog's lard, and a quarter of a part of borax. The borax is pulverized, and put into a vessel with the other ingredients, and melted over a slow fire. The mixture is to be put on the flesh side of the leather, at a tepid heat, and the application repeated, until it appears on the grain side—it is then suspended in an oven. After it is taken from the oven, it is rendered smooth in the usual way, by rubbing and bending. It is then rubbed on the flesh side with armenian bole, or red chalk.

Claim.—"What I claim is the particular compound, composed of the materials, and combined in the proportions, or nearly in the proportions, above set forth. And I also claim the manner of applying this compound, and preparing the leather for use, by exposing said leather in an oven, properly heated, in the manner, and for the purpose, herein made known, in combination with the subsequent process of filling the pores on the flesh side, with armenian bole, or other absorbent earthy matter possessed of analogous properties.

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39. For a *Molasses Gate;* Ammi West, Greene, Kennebec county, Maine, August 28.

The forward part of the tube, or body of the faucet, is made conical, the larger part being towards the cask; a conical cap fits and revolves on it. The two are kept tight by means of a screw, which passes through the end of the cap, and screws into the tube or body. A hole is made in each, through which the molasses is discharged, when they coincide, but when the cap is turned on the body, or tube, its flow is cut off.

Claim.—"What I claim as my invention, is the mode herein described, of tightening the cap upon the inner tube, by making them of a tapering or conical form, and connecting them by a screw, in the manner set forth, so that when the cap is screwed down upon the inner tube, it shall, owing to the conical form I have given the cap and tube, be made to embrace the latter more closely, and thus prevent leakage as the parts wear away."

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40. For an *Improvement in Saw-Mill Dogs;* Martin Rich, Ithaca, Tioga county, New York, August 28.

These improvements consist in a peculiar mode of constructing the

dogs—in operating the slides by means of two endless screws on the same shaft—in a combination and arrangement of parts, by which the log is set by the motion of the carriage—and in the peculiar manner of constructing the rack which sets the log.

The dogs are made of a quadrangular frame of iron, with teeth on one side; this frame slides in a mortise made for that purpose, in an iron standard, which slides in the head block. The dogs are retained in place, after being driven into the log by a screw or wedge at the top.

A shaft runs across the head-block, with two endless screws, one on each side of the kerf, which take into a rack on each of the slides which carry the dogs. The outer end of the shaft has a cog wheel, the cogs of which take into cogs on a rack, attached to a vibrating bar, for throwing the rack in and out of gear, by which the log is set. The cogs on this rack are movable, and the number of them will regulate the thickness of the set which will be given to the log.

Claim.—" What I claim as my invention is, first, the manner in which I have constructed and arranged the improved dog, as set forth, namely, the giving to it the form of a triangular frame, furnished with teeth on one side, and sliding through an opening, or mortise, in a standard affixed to, or making a part of, a sliding plate and rack, by which the log is carried in setting; said dog being held in the required position by a screw, or wedge. I claim, secondly, the arrangement and combination of the parts concerned in the setting of the log, by the return motion of the carriage: said combination consisting of the shaft, with its right and left handed screws; the cog wheel on its end, and the vibrating bar for throwing the rack into and out of gear. I claim, thirdly, in combination with the log setting apparatus, the manner of constructing the rack with movable teeth, for the purpose described."

Specifications of American Patents.

Specification of a Patent for an Improved Mode of Constructing the Packing for Pistons, &c. of Steam Engines. Granted to Charles F. Pike, *of Providence, Rhode Island, August* 12*th*, 1840.

To all to whom these presents shall come: Be it known that I, Charles F. Pike, of the City of Providence, in the county of Providence, and State of Rhode Island, have invented a new and improved mode of constructing the packing of pistons, piston rods, and valve stems, and I do hereby declare that the following is a full and exact description of the same.

The nature of my invention consists in the use of cylindrical metallic wedges, within side of metallic rings when used for the packing of pistons; and without side of metallic rings when used for the packing of piston rods, or valve stems.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation. I construct

my packing for steam engines, or other pistons, by making two rings of cast iron, or other metal, turned as large as the diameter of the cylinder, and so wide that the rings will just fill the space between the head and follower of the piston when ground together. I saw said rings open, so that they may expand to fill the cylinder. I make a cylindrical wedge as wide as the two rings afore-mentioned, the external diameter of which will just admit it to slide within the afore-mentioned two rings when they are placed in the cylinder. The internal diameter of said wedges being conical, and as much larger at one end than at the other, as may be deemed necessary, said wedges being cut longitudinally into four, or more, parts, so that each part may be forced out from the centre against the two rings afore-mentioned. I make another cylindrical wedge in the form of the frustum of a cone, and about seven-tenths as long as the one last named, the external diameter and taper of which corresponds with, and fits into the internal diameter of the large end of the other, the thickness of which I make sufficient to admit of screws being tapped into it, to move it longitudinally on the barrel of the piston. To keep said wedge in its place, I put in four, or more, screws, with collars on them, to be let into the followers, two on one side, and two on the other. Two with the collars on the inside shove the wedge ahead, and the other two hold it, or draw it, back. I construct my packing for piston rods, &c., by making two rings of brass, or other metal, of a diameter that will just admit them on the rod, and so wide as just to fill the space between the bottom, or the bushing, and the cap, when ground together, and of a thickness of about one-eighth of the diameter of the piston rod, which I cut open, and place on the rod, so as to break joints. I make a cylindrical wedge of a width and internal diameter, corresponding with the width and external diameter of the two rings afore-mentioned. I make said wedge thicker at one end than at the other, to give it the proper taper, and cut it longitudinally, into four, or more, parts, so that each part may be forced in towards the centre against the two rings afore-mentioned. I make another cylindrical wedge about seven-tenths as wide as the last named, the internal diameter and taper of which corresponds with, and fits on the external diameter of the small end of the other. The thick end I make of a proper thickness to admit of four set screws, made in the same manner as described for the piston, the external diameter of which is the same as the internal diameter of the head, or stuffing box; I fit on a cap with set screws therein, to adjust the last named wedge, so as to keep the two rings snug to the rod.

Having thus fully described the manner in which I construct and arrange the respective parts of my metallic packing, what I claim therein, and desire to secure by letters patent, is the within described manner of packing the piston of a steam engine by the combined action of the conical wedge operating upon the sectional wedges, and these upon the divided rings, the conical wedge being adjusted by set screws, the whole being constructed and operating substantially as set forth.

I also claim the employment of divided rings to constitute the pack-

ing of a piston, these having been before used, but under an arrangement of the necessary parts, essentially different from that employed by me.

I also claim the packing of piston rods, and of valve stems, by an arrangement of the respective parts constituting the packing, similar to that employed in the packing of pistons, but situated in a reversed order, the divided rings embracing the piston rods, or valve stems, as above made known. CHARLES F. PIKE.

Specification of a Patent for an Improved Apparatus for Heating the Blast of Smelting Furnaces. Granted to WILLIAM H. PHILLIPS, *of Brooklyn, New York, on the 28th of August,* 1840.

To all whom it may concern: Be it known that I, William H. Phillips, of the City of Brooklyn, in the State of New York, have invented a new and useful improvement in the manner of heating the air to supply the blast in those smelting furnaces in which mineral coal is used, and in which there is an air-heating apparatus at the tunnel head; and I do hereby declare that the following is a full and exact description thereof.

For the purpose of economizing fuel, it is a point of considerable importance to be able to use the waste heat for supplying the blast to the smelting furnace, and this has been done in numerous instances, and under various modifications of the apparatus employed. It has been found, however, that in all cases, the air so heated, is subjected to great variation in its temperature, and that from causes incident to the employment of such furnaces when dependence is had upon the waste heat alone to accomplish the intended purpose. Whatever produces a diminution of heat in the interior of the furnace must produce a corresponding effect in the air-heating apparatus, and that at a time when it is most desirable to keep up, or increase, the temperature of the hot blast, in order the more rapidly to restore the wanted temperature in the furnace. One of the most general causes of the temporary diminution of heat in the furnace is the introduction of the charges of coal, ore, and flux. The quantity of gas emitted from the fuel also varies considerably in different stages of its combustion, and with it, of course, the quantity of flame in the heating apparatus; other sources of such variation of heat are well known to those conversant with the use of smelting furnaces. My improvement is intended to, and does, effectually, obviate this difficulty, and that in the following manner.

On the sides of, or otherwise close to, the heating apparatus on the tunnel head, I place one, two, or more, small furnaces, for the express purpose of heating a portion of air which is to pass from them into the heating oven, and to co-mingle with that arising through the chimney of the smelting furnace. To these auxiliary furnaces I make close fitting doors, in order that no air shall pass into them, excepting that which is forced to pass through the burning fuel which they are to contain.

Into the ash-pit of these auxiliary furnaces I introduce a pipe, through which air, either hot, or cold, may be blown from any suitable part of the blowing apparatus, which, by passing through the ignited fuel, and thence directly into the heating oven, may be made to communicate a very high degree of heat to the pipes contained therein; I of course regulate the supply of air to be blown into the heating oven, and to pass from the blowing apparatus into the auxiliary furnaces, by means of cocks, valves, or dampers, applied in the ordinary way, which devices are well known to all machinists.

Having thus made known the nature of my invention, and shown the manner in which the same may be carried into operation, what I claim therein as constituting my improvement, and desire to secure by letters patent, is the combining with the ordinary air-heating apparatus, on the tunnel head of a blast furnace for smelting iron, by means of mineral coal, one, two, or more, small auxiliary furnaces, into the ash-pits of which air is to be blown, and to be heated by passing through ignited coal, and thence conducted immediately into the heating oven; the whole being connected and combined substantially in the manner, and for the purpose, above set forth.

I will here remark, that when it is not requisite to employ the heat from the auxiliary furnace, or furnaces, by closing the valves in the passages leading into, and from them, the contained fuel will merely remain ignited, scarcely undergoing any combustion, until urged by the blast. WILLIAM H. PHILLIPS.

Progress of Physical Science.

Notes and Diagrams, illustrative of the Directions of the Forces acting at and near the surface of the Earth, in different parts of the Brunswick Tornado, of June 19th, 1835. *By* A. D. BACHE, *Professor of Natural Philosophy and Chemistry, in the University of Pennsylvania; one of the Secretaries of the American Philosophical Society. Read April 2d,* 1836.*

IN company with my friend, Mr. Espy, I visited, in the early part of July last, the scene of the destructive tornado of June 19th, the ravages of which had been most severely felt in New Brunswick, New Jersey, and its vicinity; the effects extending about seven and a half miles to the west, and ten to the east of that place. The idea of illustrating these effects by the aid of instrumental means, first occurred to me after hearing an interesting account by Professor Johnson, before the Academy of Natural Sciences of this city, of an examination made by Professor Henry and himself, of the position of materials carried by the storm from the city of Brunswick, and deposited in a field on the opposite bank of the river Raritan.

* The views of Mr. Redfield in reference to this tornado having been recently published in this Journal, it is deemed proper to re-publish the article of Prof. Bache. – COM. PUB.

The regularity in the general arrangement of these materials, gave me the hope that further facts of interest might be brought to light by an examination of the country along the path, and fully established, as well as clearly represented to the eye, by diagrams laid down from actual measurement.

To this point I devoted exclusive attention during the limited time which a very brief recess from duty at the University afforded me. Mr. Espy collected at the same time the accounts of those who had witnessed the phenomenon, examined closely the general circumstances, and is equally concerned with myself in any claim to novelty in the results about to be submitted. As he will embody the deductions from the information collected, and from the general observations which we made, I do not propose to go into them further than is necessary to make my results intelligible.

The accompanying diagrams, plates III, IV, represent different portions of the track of the storm, from the point at which its effects were first felt in any considerable degree, to a point about a mile east from Brunswick, where I was reluctantly obliged to close my observations.

They were obtained by means which, though rough, are abundantly exact for such a purpose, namely, by measuring the angles to be taken, by the compass, and by pacing the short distances to be estimated.

Such an examination being made of the track of the tornado through a wood, or in any other suitable case, the directions of the acting forces are determined, and thus is ascertained whether they correspond to the effect of a whirl, at and near the surface of the ground, as is generally assumed, or to that of a rushing wind, or, as most fully appears, to that of a mighty column of rarefied air in motion.

Although the action of the storm on buildings, affords many interesting facts in regard to the phenomenon, and in one case, an effect of great interest was thus first pointed out; yet, as we expected, the most satisfactory evidences of the directions of the forces occur, generally, in open woods, and in the plantations near buildings.

It may seem superfluous to a reader accustomed to observation to say, that entire regularity is not to be looked for in the effects to be brought before him. I have, however, thought it best to remark briefly upon some of the causes which might be expected to produce considerable irregularities, in the positions of trees overthrown, or broken, by the storm.

The soil of the part of New Jersey through which this storm passed is a red clay, (from the red shale,) and deficient in strength. The trees growing upon it extend their roots very far horizontally, while they penetrate but a short distance below the surface. They are, therefore, readily uprooted, and in the overthrow, carry a considerable extent of soil with them.

If the forces acting during the whole period that the trees were within the sphere of action of the storm, be supposed of equal intensity but varying direction, then the trees extending their roots un-

equally in different directions, will oppose unequal resistances in those directions, and two trees side by side may be thrown different ways. Several trees presenting thus a want of conformity of direction, would induce, at first view, the idea of a total want of regularity calculated to baffle observation. If the forces vary in intensity as well as in direction, this difficulty will be increased. Again, the circumstances of the proximity of other trees, may not only influence the direction in which a tree will fall, after its motion has commenced, but the very direction in which the force producing its fall may act. And these remarks apply in even greater force to the case in which trees are broken, instead of being overthrown.

The unequal strength of parts of a building, and its protection by adjacent buildings, must produce difficulties of a similar kind; while in the trees near to houses we should look for even more irregularities of direction, than in those in an open wood.

These remarks, it will be seen, are not intended to set aside any cases which may appear inapplicable to a general conclusion, but merely to guard against unreasonable requirements.

Of the diagrams, figures 1, 4, 5, and 7, are drawn to the same scale; the scale of figures 3 and 6 are attached to them respectively; and figure 2 is not drawn to a scale.

The directions of the trunks of trees are represented in all but figure 1 by arrows. In order to make these directions appear distinctly, these arrows are out of proportion to the horizontal distances between the trees. This causes the tops of trees to appear very near, which, in many cases, were not so.

The first point to which we traced the action of the storm, was near the farm of Mr. M. S. Garretson, about seven miles, a little south of west, from New Brunswick. It crossed the Millstone river, and the Trenton and Brunswick canal, about half a mile to the west of Mr. Garretson's dwelling, and its track was between this house and a barn about sixty yards from it. A small portion of a light fence, and some other matters, were carried across the road upon which the house fronts, and a part of the trees in an orchard thrown down. Neither the barn nor dwelling house was injured, and the action was described as that of a strong wind of limited breadth. In the orchard, the trees to the south of the path of the storm, were thrown northwardly, and those to the north, southwardly. Passing on to the east, the next effect was seen in overthrowing a large cherry tree, and carrying off the southwest corner of the thatched roof of a small saw-mill. The most violent action, however, at this place, was upon a wood nearly east from the dwelling house, and is shown in the sketch figure 1, plate III. This is, perhaps, the most hasty of all the determinations which I made, as the interest which attached to the effects wanted the force of novelty: they being similar to those referred to, as observed by Professors Henry and Johnson. The ground represented in the diagram is irregular, consisting of a hill, the sides of which are covered by wood; the hill being cut by a ravine which was apparently near the northern border of the storm, or of that part in which the trees were thrown in the direction of its course. The

wood was of young hickories and black oaks, without undergrowth, but even here some irregularities were seen. The spiral growth of a few of the trees had led the proprietor of the farm to think, and speak, of the whole effects as produced by a whirlwind. He pointed out those cases, which were, obviously, seen to have resulted from the cause which I have just assigned. It will be observed in the figure, that of nine trees there represented, the two on the north side of the storm fell southward and eastward, one, *g*, points out its direction nearly, and five of the six of the south side are directed between N. 10° E., and E. 40° N. The breadth of the storm was here about 200 yards, and its direction about that of the line A, B.

We next repaired to a point where the destruction was reported to have been considerable, namely, to the farm of Mr. D. Polhemus, between two and three miles E. 17° N. from Mr. Garretson's. Here a very curious fact was developed, which I have attempted to represent in the sketch and ground plan figure 2, plate III. The building or shed attached to a large frame barn, and on the southern side of it, was moved during one part of the phenomenon to the west of north, and subsequently to the eastward. The posts (see b, figure 2) slipped from the stones, a, which supported them, when the building was first acted upon by the storm, and being carried northward and westward ploughed a furrow, c, in the soft surface of the ground, heaping up the manure, d, before them. Afterwards, being moved eastwardly, they formed another furrow, e, and a heap of manure, f, remaining in the position, b, when they were pointed out to us. As the first direction is nearly at right angles to that of the motion of the storm, the building being to the south of its axis, the conclusion is irresistible that there was, on the approach of the storm, a tendency to motion *towards* it. The second furrow shows a motion towards the receding storm. Why this building moved but in two directions, will appear from the protection afforded to the north east by a large barn, the strength of which enabled it to bear the tendency towards the moving meteor, without much injury. In figure 3, D is the shed, C the barn, and F G the probable direction of the storm, the probable axis nearly coinciding with that line. It is believed that the relative positions of the buildings there shown, are nearly correct; no particular pains were, however, taken on this score, a survey of the orchard to the east of the house, being the main object.

Of the trees in this orchard, figure 3, more than two-thirds suffered; being generally torn up by the roots. Of these there are two lying actually west of north, and seven thrown to the north of north-east; while the greatest amount of devastation is in the direction of the meteor, which passed over the western part of the orchard, the inclination of its path being about 10° N. of E. It is remarkable that some small trees, as n and o, were left standing, and were not much broken. Some large trees, as between s and g′, were also left. The former ones had probably sufficient flexibility to give way to the action of the storm without breaking; c′, b′, a′, f′, and z, were probably uprooted on the approach of the storm. The tree y, presents a curious case: it is broken into three parts, the middle one lies north, and

the two exterior ones are separated from it to the eastward and westward. It will be observed that the trees lying perpendicularly to the track of the storm, are not those furthest from the centre of that track.

While the trees on the southern edge of the storm were thrown generally northward and eastward, the few which were on the north side, were thrown to the southward. Thus at i′ is shown a large black cherry tree, uprooted and lying nearly parallel to the side of the house A, while at k′ and l′ are groups of willows, the limbs of which were broken off, and thrown to the southward and eastward. There were no trees in the meadow to the north of the orchard, and east of the group k′.

We were told by Mr. Polhemus, that the orchard of a neighbour to the west of him had been prostrated, but did not consider it advisable to return upon that point, determining rather to follow the track of the storm towards Brunswick. The general direction of Brunswick from Mr. Polhemus's house is E. 10° N.

We explored the wood belonging to Mr. Polhemus, and eastward from his dwelling, where the marks of the tornado were next to be seen. As, however, nothing of special interest was developed, I have not thought it necessary to copy the drawing made from my notes. Passing through this wood, the track was marked through fields of grain and orchards, in which the trees were uprooted, and near buildings which suffered more or less from its action.

The next point of interest occurred, where we distinctly made out that the meteor did not maintain its position at the surface of the ground; a fact which has been before observed in regard to other tornadoes. After a slight damage upon the edges of a thick wood of black oak trees, the marks of destruction were not seen until traced upon a ploughed field, to the east of the wood, in which there were a few trees. These were uprooted, and the moist earth from the surface of the field was thrown against the trees of an adjacent wood.

The next diagram, figure 4, represents a very remarkable case, establishing conclusively the direction of the forces already pointed out in figure 2, but in a case less complicated than the former.

In a tolerably open wood, we lost all traces of the storm, but pursuing a general easterly direction, came upon a part of its track where the trees were broken near the top. A little further on they were broken nearer to the trunk, and at last uprooted. A survey of the exterior of a circular space, around which the trees were overthrown, gave the accompanying representation, figure 4. The round was traced by the directions of the trees; that is, having set out at one point, I arrived at it again, by following the indications afforded by the directions of the trees. In the mean time Mr. Espy explored the interior of the round, and pointed out to me a space where the tops of the trees were lying together. The evidence of a rush towards a central space is thus conclusive.

To generalize the results of this diagram, it will be seen, that with a few exceptions to be remarked upon directly, all the trees on the southern border of the circular space A, are thrown northward; those

to the north southward; to the east westward, and to the west eastward.

These exceptions are probably to be referred, generally, to the forward motion of the spout. Thus, while c is thrown to the west of north, a tree beside it, and many like p to the south of it, were carried in the general direction of the moving column. The same is true of trees to the north of g and h. In selecting the trees to be noted, I took care to put down cases which seemed anomalous, lest something of consequence should escape observation. The irregular positions of the tops of trees at i, seem to be sufficiently explained by their interference in falling. The tree g may have had its top carried northward in falling, and lies almost directly opposed to the directions of trees to the north of it; these trees being bent permanently, but not broken. Pursuing the track of the storm along B C, the trees were thrown in its general direction.

Passing forward to the east, we lost the traces of the storm, and when they appeared again, the circumstances seen in approaching figure 4 were repeated. Figure 5 represents the recurrence of the effects produced by the descending of the column to the ground. I did not think it necessary to go round, with the compass, that part of the circle which is turned in the general direction of the motion of the spout, but merely the other portion which presents the curious circumstance of trees thrown in a general direction opposed to that of the motion, proving conclusively, that a rushing wind from the westward will not explain the effects. The fatigue incident to the previous work, made me very willing to cut off all that seemed of doubtful utility.

The next position surveyed, was at and around the dwelling of Mr. David Dunn. The destruction here was terrible indeed. The dwelling house had been unroofed, and otherwise severely injured. A large barn and stable had been torn down, the outhouses prostrated, and all the trees around the dwelling uprooted or broken to pieces. The storm had passed from an adjacent wood, about one-sixteenth of a mile to the west. All this destruction had been accomplished and an entire calm taken place, in the time that Mr. Dunn ran from the front to the back door of his dwelling, a distance of about thirty feet. This excessive rapidity of motion was no doubt one of the causes why lives were not lost, in vain attempts to escape from the effects of the storm.

Mr. Dunn received us with great kindness, and gave every information in his power, without expressing weariness at our curiosity. Indeed it is but justice to say here, that we met with uniform courtesy and kindness, along the whole route of our inquiry, and experienced no case where those whom we addressed were unwilling even to leave their work, to point out to us matters worthy of attention. For this attention we beg leave thus publicly to return our thanks.

A general glance at sketch figure 6, will serve to show that the trees near the house were thrown inwards. No case occurs in which the trees are thrown outwards from the house. Many, however, further to the north and east of the house, and which are not represented

in the sketch, were carried in the direction of the storm. A closer examination will serve to show several interesting particulars.

Of twelve trees in the row A B, south and west from the dwelling, all but three were injured, and generally uprooted. The three not injured were young black cherry trees, two were of "medium size," and the other quite small. Six of the trees were thrown between N. 4½° W., and N. W., or *towards the approaching spout*. Three were thrown towards the house, namely, the one nearest to the house, and two furthest from it: all these are large trees. Of the trees around the house, all those uprooted or broken, except q and k, point towards the house, and these were evidently caught by the trees to the west of them. s' presents a curious case: the tree was broken off, and the fragment carried towards the west; then, by a subsequent force, laid in the position s', E. 7½° S. The tops of m, n, and w, were lying together in a heap, and the limbs from the trees in this group, together with palings from a fence to the west of the house, and fragments of the outhouse, C, were strewed at x. u and t have received their direction probably from the onward motion of the spout, which heaped an immense mass of rubbish against the west side of the house, breaking it in, and destroying nearly every article of furniture in the south-west room. The house, and the area just described to the north of it, seem to have been the scene of this inward rush. The facts to prove that it was also an upward one, will be stated by Mr. Espy. The trees in a field to the north of the house, and beyond u, t, s, o, were carried eastward in the general direction of the storm; and in a field still further north, the rafters from the roof of the dwelling A were found.

Two rows of trees extended from the south side of the house to the road. These do not appear to have suffered as much as the row to the west of them. In the nearest position of the spout, they were in part protected by the house. The trees which were uprooted lie in directions extending over the sector between N. 15° W. and N. 45° E.; much the greater number of trees being thrown between north and north-east.

A tree at d' was thrown against a small porch to the north of east of it.

As the destruction to the eastward of this house renders it improbable that the axis of the spout did not touch the ground there, it seems to me that this inward rush indicates that the spout had its velocity *momentarily* checked at this point.

On the following day we examined a wood to the east of Brunswick and on the opposite side of the river Raritan. This wood is to the east of the position examined by professors Henry and Johnson, from which the debris inspected by them had been removed.

The case here presented was so complex, that I doubt much if we could have unravelled it without previous preparation. The irregularities encountered on the southern edge, see diagram figure 7, detained me so long, that I was only able generally to sketch the northern borders, the directions of the trees being, however, still taken with the compass. The inward direction of the forces is here well made

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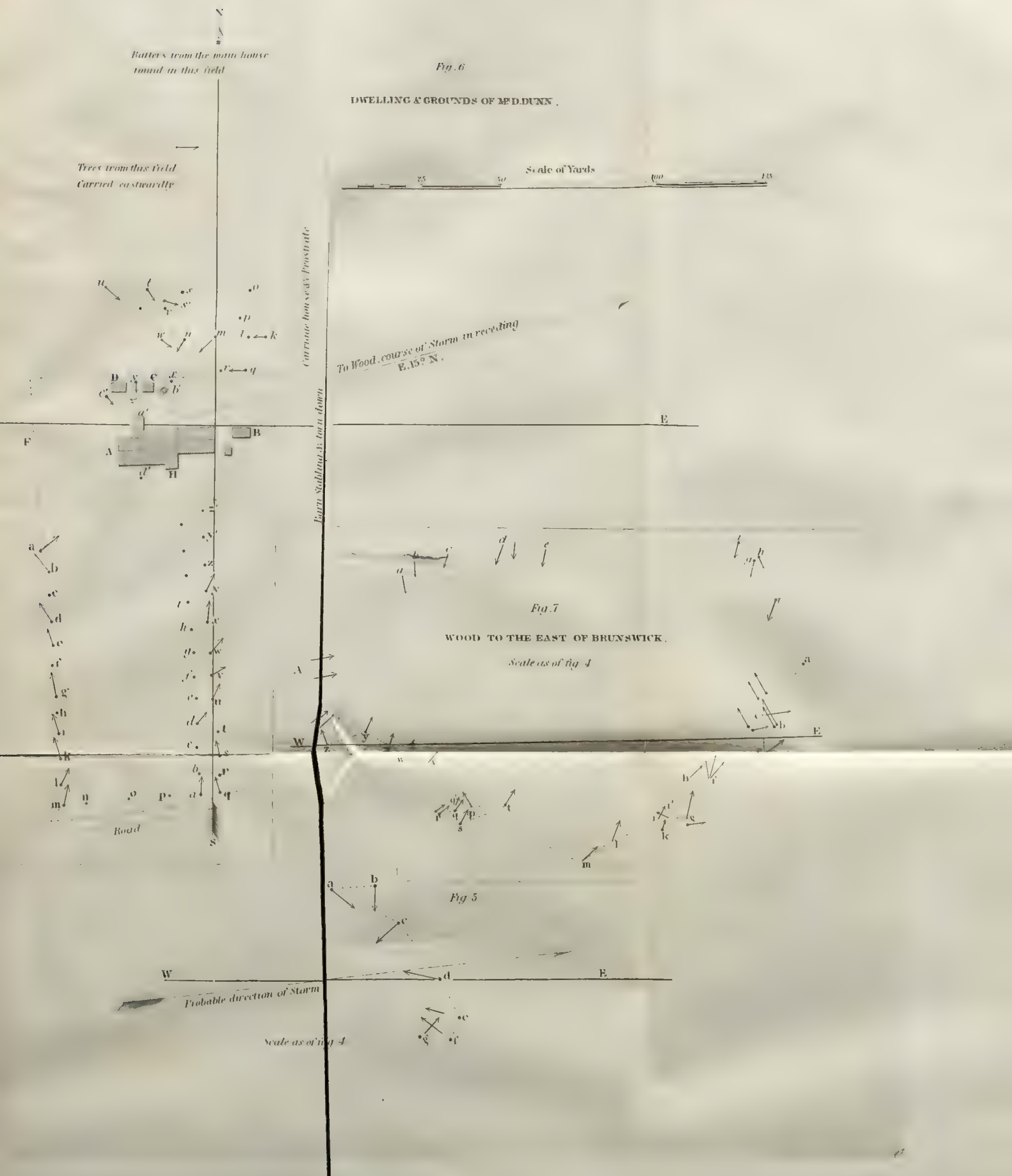


Fig. 6
DWELLING & GROUNDS OF MR D. DUNN.
Scale of Yards
25
50
100
Rafters from the main house found in this field
Trees from this field Carried eastwardly
Carriage house &c Prostrate
Barn Stabling &c torn down
To Wood, course of Storm in receding E.15° N.
N
S
E
F
A
B
H
Road
Fig. 7
WOOD TO THE EAST OF BRUNSWICK.
Scale as of fig. 4
W
E
Fig. 5
W
E
Probable direction of Storm
Scale as of fig. 4

PLATE III.

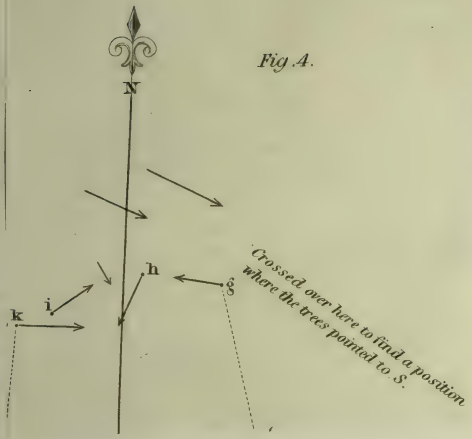


Fig. 4.

PLATE III.

Fig 1

WOOD of Mr M S GARRETSON.

Scale as of Fig 1

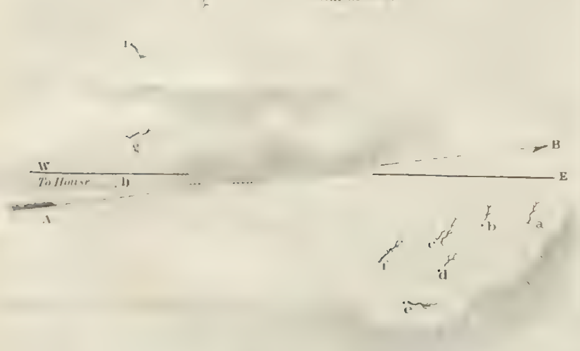


Fig 2

OUT HOUSE of Mr D POLHEMUS.

Fig 4

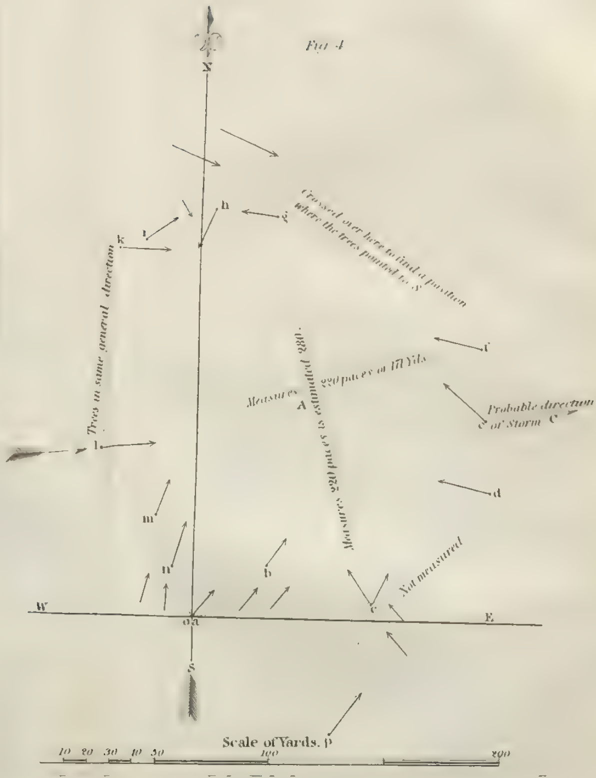
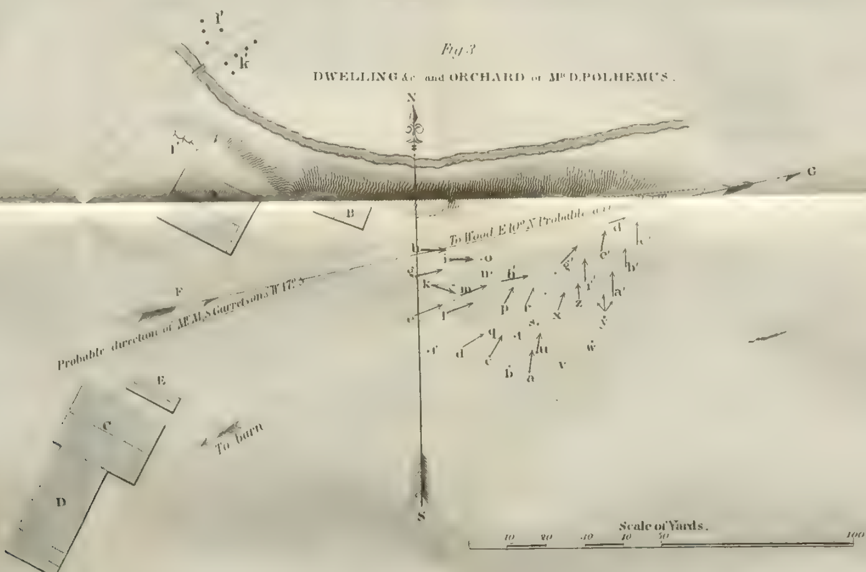


Fig 3

DWELLING &c and ORCHARD of Mr D.POLHEMUS.



out, notwithstanding the confusion produced by the subsequent forward rush of air. While I was engaged in obtaining materials for this sketch, Mr. Espy penetrated further west into the wood and beyond it. He states that the marks on the trees indicate a downward motion of the spout at this place, more obscurely made out than in the other cases before described. The nature of the ground to the west of the wood was unfavourable to an exact determination of this point, but it is probable that the spout was raised, for a short distance, above the surface of the ground.

As far as the examination of the different diagrams has shown, I think it entirely made out that there was a rush of air, in all directions, at the surface of the ground, towards the moving meteor; this rush of course carrying objects with it; and that the meteor did not always extend to the surface of the ground, and when at the surface did not move uniformly either in velocity or in direction.

In figure 1 there is no motion towards the approaching meteor exhibited; and this appears generally to have been the case along its track when moving uniformly and reaching to the surface of the ground. The reason of this readily appears, for the air in front of it would hardly be in motion, the trees carried by it hardly bent, before the second and more violent action would prostrate them in the general direction of the motion of the meteor.

Figures 2 and 3 exhibit cases of this motion in both directions, towards the approaching and towards the receding meteor. But there is no evidence here that the spout was not moving along the surface. In the case of figure 2, the motions were registered by the effects upon the ground, and the easily uprooted trees shown in figure 3, fell in directions, with one exception, between 10° W. of N. and 3° N. of E.: the meteor moving about 8° N. of E., and to the north of the orchard containing the trees.

The disappearance of the track of the storm is first satisfactorily made out in the remarks subsequent to those upon figure 3. The effect of a second case of the sort is represented in figure 4, where around a circular space, in which the tops of the trees were found lying together, is a ring in which the trees generally point to the central space. At the outlet, where the storm moved on its track, the trees are found in the ordinary directions, and the same is true to the eastward of the place in which this descent of the spout occurred.

A second case of the same kind is represented in figure 5. At Mr. David Dunn's, the evidence is against such a descent having taken place at the dwelling-house, as shown by the row of trees to the south and west of the house, see figure 6, and by the fence, trees, and shrubs of the garden to the west of the house. Yet the dwelling appears as a centre, towards which objects to the north and east of it were thrown. To account for this I have supposed a momentary, and the evidence shows that it was merely momentary, pause or check in the velocity of the meteor. Such pauses were represented to us by many spectators to have taken place, and sometimes in cases where they could hardly have been deceived. In figure 7 is shown a case in which it

is doubtful whether the effects are those of a check of velocity, or of a descent of the spout; most probably both took place.

These effects all indicate a moving column of rarefied air, without any whirling motion at or near the surface of the ground.

References to the Diagrams on Plate III.

FIGURE 1.

Wood of Mr. M. S. Garretson.

a. Tree uprooted,* N. 20° E.

b. Broken off, lies N. 10° E.

c. Hickory torn up by roots with a sapling alongside, N. 38° E.

d. Top of a black oak blown off, carried to E. 40° N.

e. Hickory broken off about two feet above the root, lies E. 1° N.

f. Black oak broken off at the root, E. 41° N.

g. E. 15° N., about thirty yards from the north edge of the storm.

h. The south east corner of Mr. Garretson's house bears W. 3° S. from this point.

i. A sapling bent over and kept in place by other trees, E. 30° S.

k. A sapling bent to E. 36° S.

FIGURE 2.

Outhouse of Mr. D. Polhemus.—Ground Plan.

a. A flat stone, on which the post b originally stood.

b. Present position of the foot of the post.

c. Groove made in earth to northward of a, by the post.

d. A mound of manure heaped up at the end of the groove c.

e. A second groove north of east in direction.

f. A mound, heaped up by the post b two feet high.

FIGURE 3.

Grounds of Mr. D. Polhemus.

A. Dwelling house of Mr. Polhemus, slightly injured.

B. Outhouses not injured.

C. Barn, shingles torn off, not many in number.

D. Shed shown in figure 2.

E. Open work corn crib, not injured.

a. N. 12° E. Uprooted.†

b. Tree uprooted, too crooked to determine its direction.

c. N. 6° E.

d. N. 27½° E.

e. E. 20° N.

f. Tree standing near the fence.

g. E. 6° N.

h. E. 3° N.

i. E. 3½° N.

k. E. 18½° S.

l. E. 25° N.

m. E. 18° N. Tolerably straight. Shingles from barn, found at the foot of m. South-east angle of the barn bears W. 30° S.

n. Tree standing.

o. Low tree standing: small.

p. N. 32° E.

q. Broken, not uprooted.

r. N. 27° E. Dead: bushy.

s. Standing. High and stout.

u. N. 24° E.

v. Plum tree near, standing.

x. N. 5° E.

z. N. 9° W. Small, firmly rooted in north side.

y. Thick and bushy: broken off into three parts, the smallest of which points west of north, the next north, and the largest east of north; the bark is stripped off below the fracture.

a′. N. 4° E.

b′. Same general direction as a′.

c′. N. 2½° E. Small roots.

d′. E. 22° N. Very large roots.

e′. N. 10° E.

f′. N. 10° W. A small tree near this, in the same row is untouched.

g′. E. 35° N.

h′. E. 3° N. Three trees at the south end of the row f′ g′ are standing.

i′. A very large black cherry tree, uprooted, and lying nearly parallel to the house.

k′, l′. Groups of willows, the limbs and branches of which are torn off, and thrown to southward and eastward.

FIGURE 4.

A Wood.

a. N. 40° E. Uprooted.

b. N. 35° E. Several in the same general direction.

c. N. 29° W. The top of a tree has fallen on c, and nearly at right angles to it.

d. W. 12° N. Uprooted.

e. W. 42½° N.

f. W. 13° N.

g. W. 4° N. It lies N. 15° W. from e, and about one-eighth of a mile from it.

h. S. 23° W. One of the last trees near the edge.

* The trees are uprooted unless the contrary is stated, or shown in the figure.

† The directions of the arrows indicate those of the trunks of the trees.

i. Top blown E. 36° N., large end foremost. Another top at right angles.

k. Top blown off E. 0½° S.

l. E. 7½° N. A tree near l is broken off and top lying to west, obviously could not go to eastward on account of the other trees.

m. N. 23° E.

n. N. 15° W. Many large and small trees, not varying in direction 5° from the direction in which this has fallen.

o. Is the same as a. Being at once the point of departure and of termination. b was also examined and identified.

References to the Diagrams on Plate IV.

FIGURE 5.

A Wood.

a. E. 35° S. Tall hickory broken off about fifteen feet from the root.

b. S. also broken.

c. S. 31½ W.*

d. W. 9° N. Uprooted. A tree near to d is broken off and carried in the same general direction.

e. Broken off and carried W. 18° N. A tree near to this and west of north of it, carried in the same general direction.

f. A large rotten oak broken off, lying W. 36° N. Its trunk at the base, fifteen feet from the fracture, measures six and a half feet in circumference.

g. A broken tree lying over f and nearly at right angles to it.

FIGURE 6.

Dwelling and grounds of Mr. David Dunn.

a. N. 40° E. A cherry tree. The west corner of the house is about one hundred feet off, and lies to N. 42½° E.

b. N. 20° W. A cherry tree uprooted.

c. Cherry tree of medium size unbroken.

d. N. 22° W. A large cherry tree uprooted.

e. N. 19° W. Uprooted.

f. Small cherry tree standing.

g. Large cherry tree N. 4½° W.

h. Cherry tree of medium size, unhurt.

i. N. 10° W.

k. Black cherry tree N. 13½° W.

l. N. 23½° E.

m. Largest cherry tree in the row, N. 10½° E.

n. Large pear tree.

o. Broken off and cut since the storm.

p. A small tree standing. A tree on the opposite side of the road is broken off, and the broken part lies to the northward.

q. A large black cherry tree lies N. 15° W.

r. Not taken.

s. Broken seven feet from the ground, and has fallen against t.

t. Not taken.

u. A large black cherry tree N. 18° E.

v. E. 30° N. Large black cherry tree, torn up and thrown from its bed.

w. N. 40° E. Black cherry tree.

x. N. 3° E. Smaller cherry tree.

y. N. 18½ E. Largest size.

z. Broken to north east.

y′. Standing.

z′. Broken.

a. N. 3° E. Very large black cherry tree.

b. Small tree not injured.

c. Larger than *b* not injured. Small.

d. Uprooted N. 45° E.

e. Small.

f. Medium size cherry tree. Not broken.

g. Broken limbs to east. A black walnut (?) tree.

h. Cherry tree broken.

i. Pear tree uprooted.

k. N. of house. W. 4° S. Small fruit tree fallen against *l*.

l. Stripped of leaves.

m. Pear tree uprooted, points, as shown in the figure, towards the house.

n. Ditto.

o. *p*. Broken fruit trees. Small.

q. Broken off and lying against *r*.

s′. Is the position of the broken part of *s*. It lies E. 7½° S.

t. Large pear tree, pointing as shown in figure.

u. Points to about ten feet east of the wash-house B. It is a broken apple tree.

v. Broken pear tree, coated with dust on the north west side.

w. Large cherry tree broken off E. 27½° S. Its top lies with those of *m* and *n*.

x. A pear tree. Broken.

y. A black cherry tree, uprooted and thrown against *z*. Lies in the line *y z a′*.

z. Black cherry tree, dirt on the north east side of it. Broken on that side, its limbs lie parallel to the house.

C, D. Two outhouses to east and west of *z*. The timbers of the eastern outhouse C, lie in the mass *b′*, which contains the tops of trees, &c. The windows of D are broken on the east, one on the west side is forced in. Clap-boards are off in part near the ground on the north side.

b′. A heap of rubbish left by the storm. Tops of trees *k*, *l*, *m*, &c., beams from C, &c.

c. A tree lying as shown in the figure.

* The trees to the directions of which the angles refer, unless when the contrary is stated, were uprooted.

d. To S. of house. A small tree broken and thrown against the porch H.

F. A fence to the west of the house prostrate, and in part carried against and into the west side of the house. All the trees and shrubs which were in this garden, are prostrate or broken.

FIGURE 7.

A wood to the east of New Brunswick.

b. N. 26° W. Two oaks close together, uprooted. Trees to N. 26° W. of *b* lie in the same general direction.

c. E. 9° N. Trees near c and to west of b lie, some directed as c, others as b.

e. E. 36° N. A small oak, which may have been deflected by the trees against which it has fallen.

f. Three trees, smallest N. 38½° E. The largest has possibly been deflected by the trees against which it has fallen: it rests N. 18½° E. One to the west of the other two is rotten; it lies N. 3½° W. Smallest and largest not wholly uprooted.

g. N. 16½° E. Uprooted. A tree to the south of this inclines to the east.

h. E. 40° N.

i. W. 18° N.

i′ Two small trees uprooted, lying under i, N. 3° E.

k. Broken. Its top lies N. 10½° E. from the trunk. Crooked.

l. N. 6° E. The top of an oak. Broken off.

m. Top off. E. 32° N.

p. N. 16° W. Three oaks uprooted.

q. N. 30° E.

q′. to N. and E. from q. Broken, N. 35° E.

r. Two oaks uprooted, E. 36° N.

s. N. 23½° E.

t. N. 32½° E. Several others not 10° from this direction.

v. A broken oak, N. 44° E.

w. Top broken off and carried to north east. Direction of the stem of top N. 20° E.

x. N. 26° E.

y. N. 10° E.

z. Top carried to N. 39° W. Some trees near, lie to N. 40° E.

a. Lies S. 2½° E. Another, near it, is in the same general direction.

b. Nearly south. A rotten stump.

c. A sound tree broken to S. 35° W.

d. Uprooted to S. 36° W. Many like this to the east of it.

e. S. 28° W.

f. S. 14° W. This tree is north of the point a.

g. S. 12° W.

h. Very nearly S. 3° E.

i. S. 6½° W.

Trans. Amer. Philos. Soc.

[TO BE CONTINUED.]

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. Boucherie, M. D.

On the Method of Penetration.

[CONTINUED FROM PAGE 185.]

After having determined the substances which were most efficacious in preserving wood, I had to seek for the means of introducing them deeply into it. The method which I sought was not only required to be complete in its scientific results, but it ought also to unite the conditions of quickness and economy indispensable to its application to the arts.

I first satisfied myself by numerous experiments upon different kinds of wood, plunging them into different liquors, that maceration, unless it was exceedingly prolonged, introduced the materials only to a very slight depth.*

I then turned my attention to mechanical means, and not knowing

* Wood plunged in saline solutions yields to them a part of its soluble matter, which forms combinations with the liquid outside of the mass, thus occasioning the loss of a part of the preserving substance, which we should always study to save.

In some experiments with salts of iron, I have seen my solutions pass into the state of a true mud.

of M. Breant's ingenious machine, I caused several imperfect apparatus to be constructed, from which I obtained no satisfactory results.

I succeeded no better in rarefying, by a regulated heat, the air included in the interior of the wood, and then plunging it at once into the solutions which I wished to introduce. By this method of operating, however, I succeeded in causing different liquids to penetrate various materials used in construction, of a very compact nature—thus I succeeded in introducing tar into stones and bricks to a great depth.

This want of success did not discourage me, and being possessed with the rational idea that it ought to be infinitely more advantageous to act upon wood in its green state, than to prepare them, after the time necessary for their complete desiccation had sensibly altered them, I began to inquire whether the force which determines the circulation during the life of the tree, did not continue after it was felled, and whether I could not employ this as an introducing agent, in order to penetrate the mass of the tree by different matters fitted to preserve it and give it new properties. I undertook some experiments in reference to this, and the success answered my hopes; I succeeded, in short, in discovering an infallible method of introducing into the very tubes which contain the alterable matters, substances which, by rendering them insoluble, prevent their decomposition and destroy their nutritive properties.

I was not aware at the time, of any examination directed to this fact. Since then, I have learned that experiments had been formerly made upon fresh plants, and young branches, in order to determine the course of the sap by the absorption of coloured vegetable solutions. These experiments were purely scientific, and before the development of the facts of which I am now about to treat, the fundamental idea had never occurred to any one of taking advantage of the vital force of plants in order to use it as a beneficial force, by the aid of which we should be able to introduce almost into the integral particles of the wood, certain matters which possessed the power of preserving it, and of giving to it new properties.

The following is the fact upon which my process is founded.

If we cut a tree of great height, and immerse the foot of it, within a suitable time, in a saline solution, whether weak, or concentrated, a strong absorption is exercised by the tree upon the liquid, which thus penetrates the tissue, and soon reaches the highest point of the stem, and even the terminal leaves, if we are careful to furnish sufficient quantity of the liquid.

Thus in six days, in the month of September, a poplar tree, ninety feet in height, and fifteen inches in diameter, the foot of which was immersed only eight inches into the pyrolignite of iron, at the temperature of eight degrees, was entirely impregnated by the liquid, of which it absorbed the enormous quantity of three and a half cubic feet.

Seeing the numerous applications of this new principle, I varied my examinations and experiments in a thousand different ways. I operated upon all the different varieties of trees which I could pro-

cure, at different seasons of the year, and with a considerable number of liquors of different natures. In the course of these researches I developed some curious facts, of the highest interest in vegetable physiology, the most obscure parts of which they illustrate. Not desiring to speak of intervascular penetration, except in reference to its applications, I reserve for another memoir, which I shall soon offer to the Academy, the facts relative to the internal organization of wood, its diseases, the course of the sap, &c. &c.

In order to give greater clearness to my observations, I shall divide this part of the work into paragraphs, upon each of the details of the process.

I. On the means to be employed to effect the impregnation of wood in the most economical manner.

In my first experiments, I raised up, by suitable means, trees which had been sawed off at their foot, and immersed their base in receptacles full of the liquor which I wished to introduce. The absorption was effected perfectly, but in regard to the quickness and economy of the work, there were great inconveniences in proceeding in this way, because the weight of a green tree of large diameter, is very considerable, and it requires not only powerful means to raise it up, but we must also find a strong resting-place to support it; but this resting-place can often be found only at a considerable distance from the tree which we wish to prepare. To overcome this difficulty, I examined whether the absorption did not go on equally in all positions of the plant, and finding that it was always equally strong, I decided to operate upon the tree whilst upon the ground; adapting very accurately to its foot a bag of water-tight stuff, which answered the purpose of a reservoir. In this way, I operated very many times with great success.

Afterwards I began to inquire whether I could not prepare a tree, whilst standing, by excavating a hollow in its trunk, and putting it, by suitable means, in communication with the reservoir filled with the liquid. In this way, I succeeded remarkably well, and by varying the nature of the liquids, and by multiplying the cavities for the reception of each one, I was enabled to impregnate the same trunk with different substances, and to produce the most varied results. I do not, at present, dwell upon this order of facts, which may, some day, become of importance, I will only remark that by this method of impregnation, the liquids are introduced, upwards and downwards, into all the sap-vessels, which have been opened, with this difference, that in an upward direction the column penetrated preserves its breadth to a very considerable height, whilst downwards it diminishes rapidly in advancing towards the roots.

I then sought to simplify this mode of preparation, and to render it more complete in its results, and in order to succeed, I adopted a new process, which has given me, already, excellent results. It consists as follows. After having stripped the tree of such of its branches as experience has taught me are not indispensably necessary to cause a strong absorption, I pierce it through and through, in the direction

of its greatest thickness, by means of an instrument, which bores a hole of three-quarters of an inch in diameter; into this hole I introduce a saw, which enables me to extend the opening in a line, to within about one inch of the surface. I thus open up the greater part of the sap-tubes of the stem, and nevertheless, leave sufficient upon two opposite points to sustain the tree in its vertical position. This being finished, I cover all the open parts with cloth covered with tar, which I fix firmly to it, and adapt to one of the circular openings, which I take care not to choke up, a tube which communicates with the reservoir.

II. Is the absorbing force the same at all seasons of the year: or does it vary in each of them, according to the kind of tree which we are examining?

My position has not enabled me to combine a sufficient number of observations to arrive at the whole truth upon this subject. I can only present a small number of facts, which show how interesting the general study of it will be, and to what unhoped-for results it may lead us.

In general, winter is a season of repose for the vegetable circulation; but in no case is this repose complete in any species. I have convinced myself of this by experiments made upon oak, hornbeam, and sycamore, in December and February; I have seen, in the cold months, the liquids mount several feet, but never to so great a height as during the spring, summer, and autumn. Of these three latter seasons, the spring appears the least favourable for a complete impregnation, and the autumn has given the best results.

This fact is in contradiction to every thing which has been admitted heretofore. Botanists, in fact, consider the spring as the epoch of the year in which the movement of the sap is most active. This arises, probably, from not having made any distinction between the movement of the sap at the surface, and its movements in the interior of the tree.

I have reason to think that these movements do not take place at the same time, and I may present, in support of this opinion, some confirmatory facts. But the result to which I am led by them differs so far from that which has heretofore been adopted, that I fear I have mistaken them. I am now busy in repeating my experiments, and if, when varied, they confirm and illustrate that which I have already observed, I will record them in another memoir, which I propose to present to the Academy.

A remarkable exception to this law, which regulates the movement of the sap, presents itself. It is presented by those resinous trees which preserve their foliage green until spring, because in them the circulating movements are preserved during the winter. I have proved this fact by experiments made upon these trees in December, and in the first days of January; I have always been able to impregnate the whole of their trunks at this season of the year. This fact ought to have been known before-hand, since the permanence of the fresh and green state of the leaves, which always have a tendency to

dry up, and then to fall, could only be caused by their constantly receiving liquids which the movement of the sap alone could carry to them.

But although the movement of the sap in this class of trees is prolonged much later than in other species, its re-appearance, after it has ceased to exist, is much more slow.*

I have observed that this new, yearly, and deep-seated circulating movement had not yet shown itself in June, and it was in confirming this fact that I discovered another, which I think worthy of mention.

Upon the 25th of May, 1839, after cutting a pine in bud† of eighteen inches in diameter, and of a great height, I suspended it to a neighbouring tree; I dipped its lower extremity into a reservoir full of pyrolignite, and I suffered the experiment to continue for eight days. When this time had elapsed, I was not a little surprised to find that the level of the liquid in the reservoir had scarcely fallen. I felled the tree, and upon examining it, by cutting in at different points, I found that, in general, it had absorbed nothing, even at its lowermost parts, but that for a thickness of one inch, and to an extent of forty feet, the face which looked towards the south-east was well impregnated. This fact, besides demonstrating that the sap is but slowly put in motion in the pine, renders evident the influence of exposure, which had been before remarked, and accounts also for the greater development which is generally presented upon that side of the tree which faces the south-east.

III. Is the absorption more active and energetic, in proportion as the tree is more vigorous, its branches more numerous, and its foliage more abundant, and better developed?

In a practical point of view, it was interesting to determine whether all the branches were indispensable for effecting the impregnation; for if it was found that they were not necessary, it became possible to remove isolated trees to a central place, in order to prepare them there. I have assured myself, by several experiments, that the greater part of the trunk of a tree can be penetrated, notwithstanding the removal of almost all of its branches. The terminal foliage of the tree must always be preserved.

IV. What time may be suffered to elapse between the cutting and the preparation of the tree, preserving always proper conditions for the penetration?

This time varies with the season of the year, and the species of tree. At the end of September, a pine tree, sixteen inches in diameter, was not dipped into the liquid until forty-eight hours after it was cut, and nevertheless, was perfectly impregnated. In June, the same result took place with a sycamore tree, which had been cut thirty-six

* The movement of which I speak is that general movement which permits the introduction, to a great depth. of the liquids which are presented to the base of the tree; it must be carefully distinguished from that which converts the buds into leaves, and furnishes nutriment to all the spring-shoots. This latter movement exists in the pine as early as the month of April.

† Pin gemmé.

hours. Having at my disposal but a small number of trees, I did not wish to run the risk of waiting longer; but it is probable that even after a longer delay, I should have been able to impregnate, if not the whole length of the tree, (which is never of any use,) at least so much of it as is useful in building.

In all cases, the sooner we commence operations, after the cutting, the stronger is the absorption. It decreases rapidly after the first day, and is generally scarcely sensible upon the tenth day. These ten days are sufficient for a complete impregnation when we operate under favourable circumstances. In some cases I have observed that in seven days the liquor has risen to from 90 to 100 feet. The experiment was made upon a poplar.

V. Are the quantities of different liquors, which can be introduced in this way, considerable? Is the absorption of neutral liquids more abundant than that of acid or alkaline solutions?

Of all the secondary facts which arrange themselves around the primary facts of absorption, and are the consequences of it, this is the most remarkable. The quantity of liquors introduced is really enormous. A sycamore tree of one foot in diameter, absorbs, in seven days, nearly ten cubic feet of chloride of calcium, at fifteen degrees, and a tree of the same kind, in the same space of time, dried up a reservoir which contained seven cubic feet of pyrolignite of iron, at 6° Fahrenheit. With other species I obtained similar results, and always with quickness when I operated under favourable circumstances. Apriori these remarkable facts could not have been anticipated. Every thing would have induced us to believe, on the contrary, that the vitality of the vessels would be diminished by the contact of liquids so different from those which they ordinarily convey, and that the consequence would be the stoppage of the absorption. Experiment has shown that this is not the case. But let us cite more precise results.

Upon the 5th of August I dipped the extremity of a sycamore branch in chloride of calcium, (muriate of lime,) at 15°. At that time it weighed 2620 grammes—having finished the experiment upon the 13th, I found that it had absorbed 2000 grammes of the chloride, and its weight was reduced to 2466 grammes.

A second experiment, made also on the 5th of August, upon sycamore, gave me similar results. The branch weighed 2880 grammes at the commencement of the experiment; upon the 13th, it presented the same weight, and had absorbed 2430 grammes of chloride of calcium. A third branch of sycamore, weighing 4000 grammes, had absorbed, in eight days, only 880 grammes of pyrolignite, at 8°. In this case the absorption of the pyrolignite was relatively much less than that of the chloride of calcium. Every thing leads us to believe that this result is due to the fact, that acting as an astringent this salt contracts the vessels, shrivels them in some way, and thus materially diminishes their capacity—the horny state of the leaves, (*raccornissement*,) which is always seen, indicates an action of this kind, which

is never seen when we operate with chloride of calcium.* In this latter case, on the contrary, the leaves remain soft and flexible, even after being left to themselves for two years.

The size of the molecule of the body which we wish to introduce, certainly plays a remarkable part. It would, perhaps, not be impossible to measure it comparatively, by presenting it to the absorbing action of different kinds of wood, and a success of this kind would open a new scientific path, and offer to analysis a method for the perfect separation of bodies, which, heretofore, we have only been able to study after they have undergone a change in their nature, brought about by the means used to isolate them.

In order to determine the quantities of different substances absorbed, I repeated the weighings, of which I have just spoken, a great number of times, and always obtained similar results for the same species of trees. The same materials have always been absorbed in great volume, or always in but very small quantities. The neutral salts have always been found in the first class, and all acid and alkaline salts in the latter.

In order to determine the relation existing between the quantity of matter introduced into the branches, and that absorbed by the trunks of the trees, I had recourse to the incineration of these different parts, and thus assured myself that the differences were very trifling.

[TO BE CONTINUED.]

Metallic Relief Engraving.

Take a tablet of plaster of Paris, and, having heated it, apply wax for absorption to all the faces, save that on which you intend your drawing to be, and to that one apply your drawing, executed with lithographic ink, on lithographic transfer paper. Let the side of the tablet on which is the transferred drawing, be now dipped in weak acid and water, and then permitted to absorb a solution of sulphate of copper. By electro-metallurgy a deposition of copper can be made on all parts stained with the sulphate. Ere this coating be too thick, let the tablet be removed from the vessel in which this last operation has been carried on, washed *carefully*, dried, and a mixture of isinglass and gin be poured on it; its redundancy be gently blotted off with blotting-paper till the surface be level (*i. e.* the copper lines and isinglass cement be of the same height:) again, let the deposition take place, and again its succeeding operation; after which let common

* I will here remark that the modifications which the leaves present, under the influence of different re-agents absorbed by their stem, enabled me to measure, with great accuracy, the poisonous properties of different substances. Thus having plunged branches of poplar of the same size, taken at the same time from equal heights upon the same tree, into vessels containing water, the chlorides of calcium and sodium, pyroligneous acid, sulphuric, hydrochloric, and arsenious acids, and the sulphates of zinc, iron, and copper, and the deutochloride of mercury, I observed that the absorption of the five first liquors continued to go on, by the aspiration of the leaves, which remained healthy, whilst in the other solutions the absorption had, for a long time, ceased in the branches, the leaves being faded and withered.

black lead be rubbed over the whole surface; and the deposition being renewed, a copper mould, from which a type metal block may be subsequently cast, is now formed.—*Another method.*—Draw with a pen dipped in warm isinglass coloured cement, and when your drawing is dry, for an instant expose it to steam, and then coat it with leaf gold. Proceed by electro-metallurgy, as in last method, and no cast is necessary.

Athenæum, Feb.

Electrotype.

M. Kobell, of Munich, presented some engravings through M. Brongniart to the French Academy, which were produced by a modified process of his own. Upon a well polished plate of copper, or silver, he executes a painting of the subject to be engraved. The colour which he employs is oxide of iron, pounded with essence of turpentine, and mixed with a certain quantity of the same essence thickened by standing, or, what is equally good, with a solution of the resin of Dammera in the essence of turpentine; he sometimes adds formate of silver. This painting is obviously monochromous, and the variety of tints is produced by the different thicknesses of the colour applied upon the plate of silver; so that the lights are given by the metallic surface, and the half tints and the shades by the greater or less thickness of the colour. When the painting is well dried and adherent to the plate, it is to be deposited in an electrotype apparatus, in order to receive the deposit of copper, which takes place immediately upon the parts not covered by the painting, more slowly upon those which are only covered by a thin layer, and more tardily still upon those parts where the thickness is greatest. After several successive applications, when the thickness is sufficient to support the action of the copper-plate press, the deposit is to be separated from the plate, and the former, if any remain adherent, may be disengaged from the painting, by washing with ether; we have then a mould of the painting, executed in relief upon the silver plate; and we may conceive that if we take an impression by the ordinary copper-plate press, the colour deposited upon the paper will possess the thickness of the original painting, and will be faithfully re-produced.

Ibid, Dec.

Distinguishing Signal for Steamboats.

The inventor is Mr. Francis Melville, who, from a praiseworthy desire to promote the general safety, has devoted much of his time to the subject. Mr. Melville's plan is to place in front of the funnel of the steamer a lamp, with a clear light, and a strong reflector, having an external sliding cover attached to its face, so fitted as completely to obscure the light within, but to be made to move up and down the whole length of the lantern by means of a rod affixed to a small lever power connected with the engine, so that the motions or alterations of the slider would be at the rate of twenty in a minute. At the bottom is to be added a flat sole, made so as to carry the rays of light

completely over the side of the vessel, in order that the reflection from any object on deck may not interfere with the pilot. By means of this simple apparatus, a signal will be produced perfectly distinct from any other known in navigation, and by means of it a steamer will, at the first sight, be known from any other vessel. Though the exhibition which we had an opportunity of observing was necessarily imperfect, (being displayed from a window,) enough was, nevertheless, witnessed to show at once the perfect practicability and adaptation of the signal to the purpose intended.—*Glasgow Argus.*

London Railway Mag.

Meteorological Observations for August, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	60	67	29 76	29.86	N.	Mod rate.	.10	Rain—cloudy.
☉	2	60	78	30 05	30 00	E	do.		Clear—do.
	3	62	80	.20	.15	S.ISE.	do.		Clear—do.
	4	66	83	.07	.07	W.	do.		Cloudy—clear.
	5	72	75	29 90	29 90	S.	do.	.45	Rain—drizzle.
	6	64	79	.85	.85	W.	do.		Clear—do.
	7	64	80	.86	.90	W.	do.		Clear—cloudy.
	8	66	80	95	.95	W.	do.		Clear—lightly cloudy.
	9	70	80	90	.90	SW.	do.		Cloudy—do.
☽	10	71	78	.95	.95	E.	do.		Cloudy—rain.
	11	72	78	.90	.9	SW.	do.	3.70	Rain—do —rain in night.
	12	66	75	30.00	30.02	SW	do.		Cloudy—do.
	13	66	75	29.95	29 95	WS.	Calm.		Cloudy—do.
	14	65	80	.90	.95	SE.	Moderate.		Cloudy—do.
	15	67	77	30 10	30.15	E.	do.		Cloudy—lightly cloudy.
⊗	16	62	77	.20	20	E.	do.		Cloudy—lightly cloudy.
	17	60	78	.10	.03	W.	Calm.		Cloudy—partially cloudy.
	18	64	80	29.96	29 96	SW.	Moderate.		Lightly cloudy—do —do.
	19	62	79	.95	.90	W.	do.		Partially cloudy—clear.
	20	64	83	.90	.90	SW.	do.		Clear—lightly cloudy.
	21	71	85	.90	.90	SW.	do.	.39	Partially cloudy—rain.
	22	70	75	.85	.85	SW.	do.	.25	Cloudy—rain.
☾	23	64	74	.95	30.04	NE.	do.		Lightly cloudy—clear.
	24	62	75	30.14	.20	E.	do.		Partially cloudy—clear.
	25	58	76	.20	.16	SE.	do.		Lightly cloudy—clear.
	26	59	70	.05	.00	S.	do.		Cloudy—rain.
	27	66	75	29.84	29.84	NE.	do.	.50	Rain—cloudy.
	28	70	77	.85	.90	E.	do.	.73	Fog—rain.
	29	72	82	.97	30 00	W.	Calm.		Cloudy—clear.
	30	69	76	.98	29.96	SE. S.	Moderate.	.45	Thunder shower—flying clouds.
	31	67	78	.85	.85	W.	do.		Clear—do.
	Mean	65.64	77.58	29.97	29.97			6.57	

	Thermometer.		Barometer.	
Maximum height during the month,	85 00	on the 21st.	30.20	on the 3rd, 16th, 24th, 25th.
Minimum " "	58 00	" 25th.	29.76	" 1st.
Mean	71.61		29 97	

Correction.

In the article on Embankments of Earth, published in our last number, page 168, instead of general formula

$$\frac{\left(\frac{60}{\frac{a}{100}+4}\right)^b}{f}=x \quad \text{read} \quad \frac{\left(\frac{60}{a+4}\right)^b}{f}=x.$$

S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
[illegible]	⅓	2	⅔	4⅔	1	.	3	....	.	......	....	..	1450
⅓	1	2⅔	⅔	9⅓	⅔	.	⅔	....	.	.....	....	..	1521
[illegible]	.	1⅔	.	3	.	.	17⅔	....	.	.....	....	..	1467
⅔	.	10	⅔	8	.	.	.	....	.	......	....	..	1504
[illegible]	.	1	.	4⅔	.	⅔	4⅓	....	.	......	....	..	1463
	.	6	.	4	2⅓	6	⅔	....	.	......	....	..	1458
	⅓	2	1⅓	7⅓	.	.	4	....	.	......	....	..	1456
	1⅓	1⅔	1⅔	4	1⅔	.	⅔	44.83	3	......	49.94	3	1470
⅓	.	⅔	.	9⅔	.	.	2	....	.	......	....	..	1454
[illegible]	.	4⅔	⅓	4	⅓	1	.	....	.	.....	51.73	..	1461
[illegible]	.	1⅔	.	7	.	10⅓	1⅓	....	.	.....	....	..	1451
⅓	⅓	2	3	3⅔	⅓	5⅔	1⅓	40.08	18	.....	47.17	18	1452
	⅓	1⅓	⅔	5⅓	⅔	1⅔	.	42.87	4	.....	50.25	4	1525
	.	19⅓	.	.	.	.	⅔	....	.	.....	....	..	1475
⅓	.	8⅓	.	1	.	.	1⅓	....	.	.....	....	..	1476
⅔	.	8⅓	.	3⅔	⅓	1⅔	1	....	.	......	...	..	1462
⅔	1⅓	⅔	4	8⅔	2	.	1	....	.	.. .	....	..	1453
⅓	1⅓	4	2	1	⅓	5	2⅓	....	.	.....	....	..	1460
⅔	.	5	.	3⅔	.	5⅔	.	....	.	......	....	..	1471
⅓	.	1	.	13⅔	.	.	3	....	.	.....	....	..	1466
[illegible]	.	⅔	.	6⅔	.	6	5	....	.	......	....	..	1468
⅓	.	6	.	2⅓	.	.	.	....	.	......	....	..	1482
[illegible]	⅔	3⅔	.	4⅔	.	.	6⅓	....	.	......	....	..	1465

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

APRIL, 1841.

Thermometer.

County.	Town.	Observer.	7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.
1 Philadelphia,	Philadelphia,	G. P. Schively,	46.09	53.40	47.56	66.00	31.00	49.02	2 2/3	27.50	40.42	.
2 Montgomery,												
3 Bucks,	Newtown,	L. H. Parsons,	41.93	50.90	43.47	65.00	27.50	45.43	.	24.50	37.79	.
4 Lehigh,												
5 Northampton,	Easton,	Charles Elliot,										
6 Monroe,	Stroudsburg,	A. M. Stokes,	38.11	48.94	.....	63.00	29.00	43.52	18 1/3	....	....	.
7 Pike,	Milford,	Ralph Bull,										
8 Wayne,	Honesdale,	W. Richardson,										
9 Susquehanna,	Silver Lake,	E. Rose,	38.93	48.63	42.93	73.00	27.00	43.50	.	26.00	35.73	.
10 Luzerne,	Wilkesbarre,	V. L. Maxwell,	41.37	52.6	43.80	74.50	28.00	45.92	1 1/3	22.50	38.68	13
11 Schuylkill,	Port Carbon	P. C. Lyceum,	40.97	54.96	40.20	77.00	29.00	45.38	2/3	20.00	34.90	.
12 Berks,	Reading,	C. F. Egelmann,										
13 Chester,	West Chester,	Wm. W. Jeffris,	43.46	53.12	46.92	68.25	30.00	47.83	4	26.00	37.59	4
14 Delaware,	Haverford,	Haverford School,										
15 Lancaster,	Lancaster,	Conservatory of Arts,	45.02	55.64	46.22	70.00	31.50	48.96	2/3	29.00	40.55	.
16 York,												
17 Lebanon,												
18 Dauphin,	Harrisburg,	J. Heisely,	45.44	53.30	50.36	66.00	34.00	49.70	2 2/3	30.00	41.70	.
19 Northumberland,	Northumberland,	Andrew C. Huston,	43.28	53.53	46.23	70.00	31.00	47.68	.	23.00	35.70	.
20 Columbia,	Danville,	C. H. Frick.										
21 Bradford,												
22 Tioga,												
23 Lycoming,												
24 Union,												
25 Mifflin,												
26 Juniata,	Mifflintown,	J. A. Kinkead,	40.38	55.93	43.84	75.00	24.00	46.32	1 1/3	....	....	.
27 Perry,												
28 Cumberland,	Carlisle,	Prof. W. H. Allen,	42.83	50.29	43.32	67.00	29.00	45.48	1 1/3	27.00	38.53	.
29 Adams,	Gettysburg,	Prof. M. Jacobs,	42.00	53.71	45.18	69.00	29.00	46.97	.	26.00	37.87	.
30 Franklin,												
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	41.90	57.25	46.50	77.00	29.00	45.55	2/3	....	....	.
32 Centre,	Bellefonte,	John Harris,										
33 Potter,												
34 M'Kean,	Smithport,	M. R. Atkins,	35.72	46.87	39.10	71.00	22.00	40.56	2/3	20.00	37.33	6
35 Clearfield,												
36 Cambria,	Ebensburgh,	Richard Lewis,	35.83	49.15	38.40	71.00	21.00	41.13	1	18.00	33.30	.
37 Bedford,	Bedford,	Samuel Brown,	41.51	53.88	45.07	77.50	27.00	46.82	1	....	....	.
38 Somerset,	Somerset,	George Mowry,	39.06	50.93	42.86	74.00	20.00	44.28	3 1/3	23.00	35.16	2
39 Indiana,	Indiana,	Richard White,										
40 Jefferson,	Rose Cottage,	C. C. Gaskell,										
41 Warren,	Warren,	J. E. King,	43.87	55.73	39.00	85.00	23.00	46.20	.	....	....	.
42 Venango,	Franklin,	Wm. Connely,	......	....	......	......	....	......	.	....	....	.
43 Armstrong,												
44 Westmoreland,												
45 Fayette,	Uniontown,	J. P. Weethee,										
46 Green,												
47 Washington,	Cannonsburg,	Prof. A. H. Campbell,										
48 Allegheny,	Pittsburgh,	J. P. Bakewell,	45.37	52.17	.....	82.00	32.00	48.77	10 1/3	....	....	.
49 Beaver,	Beaver,	James Allison,										
50 Butler,	Butler,	Jacob Mechling,	41.60	52.00	47.77	77.00	26.00	47.12	.	....	....	.
51 Mercer,	West Greenfield,	S. Campbell,										
52 Crawford,	Meadville,	David Dick,	37.73	51.53	38.67	83.00	21.00	42.64	.	17.00	31.40	.
53 Erie,	Erie,	Park & Reid,										

Barometer. / Weather.

County.	Bar. 7, A. M.	Bar. 2, P. M.	Bar. 9, P. M.	Bar. Maximum.	Bar. Minimum	Bar. Mean.	Bar. Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	29.87	29.95	29.94	30.50	29.10	29.92	2 1/3	13	14 2/3	2 1/3	15	4	2	1	......
3 Bucks,	29.93	29.92	29.91	30.46	29.02	29.92	.	10	19 2/3	1/3	16	2	1	1	5.470
6 Monroe,	29.19	29.07	......	29.68	28.06	29.13	18 1/3	2	9 2/3	18 1/3	....	....	..	..	......
9 Susquehanna,	28.03	28.03	28.03	28.37	27.10	28.03	.	12 1/3	17 2/3	.	4	1	....	2	2.115
10 Luzerne,	29.34	29.25	29.30	29.79	28.45	29.30	1 1/3	9 1/3	18 1/3	2 1/3	13	2	2	..	......
11 Schuylkill,	29.29	29.29	29.23	29.71	28.57	29.27	2/3	10 2/3	18 2/3	2/3	8	1	2	1	4.297
13 Chester,	29.41	29.40	29.37	29.64	28.54	29.39	4	6 2/3	19 1/3	4	11	4	....	1	4.819
15 Lancaster,	29.43	29.41	29.41	29.94	28.53	29.42	2/3	11 1/3	18	2/3	11	2	1	1	3.957
18 Dauphin,	29.71	29.69	29.68	30.19	28.89	29.68	2 1/3	.	.	.	7	3	....	1	4.472
19 Northumberland,	29.40	29.36	29.38	29.89	28.51	29.38	.	5 2/3	24	1/3	14	2	1	..	4.424
26 Juniata,	29.41	29.41	29.40	29.93	28.53	29.41	1 2/3	7	21 1/3	1 2/3	11	2	....	..	5.030
28 Cumberland,	29.34	29.30	29.33	29.81	28.56	29.32	1 1/3	8	20 2/3	1 1/3	9	3	....	..	4.902
29 Adams,	29.34	29.33	29.32	29.86	28.55	29.33	.	11 2/3	18 1/3	.	9	2	1	1	4.679
31 Huntingdon,	29.31	29.23	29.27	29.73	28.53	29.27	2/3	17	13	.	8	2	....	..	4.891
34 M'Kean,	....	....	....	....	....	....	.	8 1/3	20 1/3	1 1/3	9	3	....	..	.. ...
36 Cambria,	27.87	27.81	27.82	28.81	27.06	27.83	1	6 2/3	22 1/3	1	8	3	....	..	2.781
37 Bedford,	29.18	29.13	29.14	29.62	28.39	29.15	1	9 2/3	19 1/3	1	9	2	....	..	......
38 Somerset,	27.81	27.73	27.81	28.20	27.10	27.78	2 1/3	8	19 2/3	2 1/3	8	3	2	..	2.541
41 Warren,	28.63	28.64	28.64	28.98	28.00	28.64	.	5 1/3	24 2/3	.	9	....	....	..	2.033
42 Venango,	28.83	28.92	28.87	29.41	28.10	28.87	3	.	.	.	9	....	....	..	1.990
48 Allegheny,	29.21	29.16	29.17	29.69	28.41	29.18	1/3	9	20	1	10	....	4	1	3.492
50 Butler,	28.75	28.73	28.70	29.20	28.00	28.73	.	.	.	.	13	2	....	..	4.207
52 Crawford,	28.81	28.76	28.77	29.30	28.04	28.78	.	8 1/3	21 2/3	.	9	1	1	..	......

Winds. / Hygrometer.

County.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	2/3	1	6 1/3	1/3	.	.	2 2/3	.	2 1/3	1	4	1/3	2	2/3	4 2/3	1	.	3	....	.	......	....	..	1450
3 Bucks,	1/3	2/3	6 2/3	.	1/3	1/3	2/3	1/3	1	1/3	4 1/3	1	2 2/3	2/3	9 1/3	2/3	.	2/3	....	.	......	....	..	1521
6 Monroe,	1	2/3	2	.	1 1/3	.	.	2/3	1/3	2/3	1	.	1 2/3	.	3	.	.	17 2/3	....	.	......	....	..	1467
9 Susquehanna,	4 2/3	.	.	.	.	.	1 2/3	.	1/3	.	4 2/3	.	10	2/3	8	.	.	.	....	.	......	....	..	1504
10 Luzerne,	3 1/3	.	6	.	2/3	.	1 1/3	.	1/3	1/3	7	.	1	.	4 2/3	.	2/3	4 1/3	....	.	......	....	..	1463
11 Schuylkill,	1 1/3	1	3	.	2	.	2	1/3	2/3	2/3	.	.	6	.	4	2 1/3	6	2/3	....	.	......	....	..	1458
13 Chester,	3 1/3	1 1/3	3 1/3	.	1	1/3	1	1/3	1 1/3	2	1	1/3	2	1 1/3	7 1/3	.	.	4	....	.	......	....	..	1456
15 Lancaster,	1 2/3	1 2/3	2 1/3	1	2	1 1/3	2	2	2 1/3	1 2/3	1	1 1/3	1 2/3	1 2/3	4	1 2/3	.	2/3	44.83	3	......	49.94	3	1470
18 Dauphin,	3 2/3	.	2/3	.	.	.	6 1/3	.	4 2/3	.	2 1/3	.	2/3	.	9 2/3	.	.	2	....	.	......	....	..	1454
19 Northumberland,	4	.	5 2/3	.	2 1/3	.	3 1/3	1/3	2	.	2	.	4 2/3	1/3	4	1/3	1	.	....	.	.....	51.73	..	1461
26 Juniata,	.	.	2 2/3	.	1	.	4	.	.	.	2	.	1 2/3	.	7	.	10 1/3	1 1/3	....	.	......	....	..	1451
28 Cumberland,	1 1/3	1	2 1/3	1 1/3	1 1/3	1/3	1	1/3	2 1/3	.	2 1/3	1/3	2	3	3 2/3	1/3	5 2/3	1 1/3	40.08	18	.....	47.17	18	1452
29 Adams,	3	1 1/3	4 1/3	2/3	2/3	.	2/3	2/3	5	2/3	3	1/3	1 1/3	2/3	5 1/3	2/3	1 2/3	.	42.87	4	.....	50.25	4	1525
31 Huntingdon,	.	.	.	.	10	.	.	.	.	.	.	.	19 1/3	.	.	.	.	2/3	....	.	......	....	..	1475
34 M'Kean,	2 2/3	.	.	.	4	.	5 1/3	.	3	.	4 1/3	.	8 1/3	.	1	.	.	1 1/3	....	.	......	....	..	1476
36 Cambria,	1 2/3	.	1 1/3	.	2	.	3	.	1 1/3	.	5 2/3	.	8 1/3	.	3 2/3	1/3	1 2/3	1	....	.	......	...	..	1462
37 Bedford,	1	2/3	2/3	1/3	2/3	.	3 1/3	2/3	1/3	1 1/3	5 2/3	1 1/3	2/3	4	8 2/3	2	.	1	....	.	.. .	....	..	1453
38 Somerset,	1/3	.	2	2/3	2 2/3	.	2	.	3	.	3 1/3	1 1/3	4	2	1	1/3	5	2 1/3	....	.	......	....	..	1460
41 Warren,	1 2/3	.	1 1/3	.	1 1/3	.	3 1/3	.	3 1/3	.	4 2/3	.	5	.	3 2/3	.	5 2/3	.	....	.	......	....	..	1471
42 Venango,	.	.	.	.	.	.	8 2/3	.	1/3	.	3 1/3	.	1	.	13 2/3	.	.	3	....	.	......	....	..	1466
48 Allegheny,	.	.	2	.	1 2/3	.	3 2/3	.	1 1/3	.	3	.	2/3	.	6 2/3	.	6	5	....	.	......	....	..	1468
50 Butler,	1/3	.	2 1/3	.	10	.	.	.	1/3	1/3	8 1/3	.	6	.	2 1/3	.	.	.	....	.	......	....	..	1482
52 Crawford,	4 2/3	.	.	.	1	.	1 1/3	.	5 2/3	.	2	2/3	3 2/3	.	4 2/3	.	.	6 1/3	....	.	......	....	..	1465

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Civil Engineering.

Extracts from the Treatise on Geodesy, by L. B. Francœur. *Translated by* W. H. Emory, *Lieut. U. S. Topographical Engineers.*

[continued from page 224.]

On the Measurement of Bases.

The measurement of a distance appears the easiest of all geodesic operations, whereas, in fact, it presents the greatest difficulties when great precision is required. It is not sufficient, as in ordinary topographical operations,* to estimate the base by stepping it off, or measuring it with a chain, because the slightest error committed, rapidly increases when the sides of the triangles, composing a series, are obtained from it by calculation. When a base is to be measured, a piece of even ground is selected, which is clear and nearly level, and of about 10,000 metres, [nearly 11,000 yards,] in length. A right line is then traced on it, with stakes placed vertically in the ground. The ends of the stakes which go into the ground

* M. Moynet made various experiments in the Island of Elba, to ascertain the error from measuring with the chain, and he found an error of only 56 centimetres, [22,04776 inches,] in a base of 5165,82 metres, [about 5,600 yards.] The base was that of the Castello light-house.

When a sketch of a country is made in the presence of an enemy, distances are measured by pacing. The length of each pace varies with the person making it, and is determined by experiment. It is usually three feet.

Distances are sometimes measured by the report of a cannon, which travels 180 toises, [1180.25 feet,] in a second, in calm weather. This manner of estimating distances, however, is very defective.

are shod with iron, and the other ends are painted black. To facilitate the alignment the engineer makes use of a theodolite, or repeating circle, by placing it in such position that the axis of the tube of the telescope will revolve in the vertical plane passing through the stakes.

The line being established with precision, rods of a known length are used to measure it. Two rods of equal, or nearly equal length, are made use of, and the mean between them is taken as the length of each. They are placed along the stakes, end for end, and are moved in succession.

122. Wood is the material usually preferred for making these rods, as its expansion is chiefly in the transverse section, and its length is not materially increased by heat. They are preserved from the effects of moisture by being soaked in boiling linseed oil, and varnished. To prevent them from warping they are made and put together as represented in figure 68. Their precise length is known by submitting them to a standard, hereafter described. Metallic plates are fitted to each end of the rods to prevent them from chafing, and to ensure more perfect contact. Sometimes a nail with a convex head is driven in the ends of each rod, and contact is produced by bringing together these two segments of a sphere. In this case, the length of each rod is the distance between the two extreme points of the convex surfaces.

123. The rod is brought into a horizontal position by being placed on a board, shorter than itself, supported by two solid tripods. The platforms of these tripods, upon which the board rests, is elevated, or depressed, by means of prismatic rods worked by screws. The measuring rod is moved about on the board, until fixed in its position, on rollers.

When the ground is uneven, or sloping, one of the rods will be lower than the other, and the two ends are then placed in the same vertical line by being brought in contact with the delicate thread of a plumb line, the weight being immersed in water to prevent it being moved by the wind. This means of adjusting the ends of the rods is, in fact, better than the first, because it is almost impossible to avoid producing some *recoil* when they are brought in contact with each other. It is necessary, in this case, to add something for the thickness of the thread of the plumb line, a quantity apparently insignificant, but which amounts to something when repeated as many times as there are lengths of the rod in the distance to be measured.

124. There is another contrivance frequently made use of, by which the contact between the ends of the rods is easily effected. It is a small rule, called the *tongue*, which moves along two grooves cut in the rod, and is worked by means of a delicate rack and pinion. It

carries a vernier, which slides along the divisions of equal parts marked on the rod, by which the observer can read the length it is made to protrude from the rod. Then the total length of the rod will be its length as measured under the standard, plus the length which the tongue protrudes. The rods made use of to measure the bases of Melun and Perpignan, were constructed in this manner. By the aid of a magnifying glass the length of the rod can be read to the one hundred thousandth part of a toise, [.0007874 inches.] For a more detailed account of this contrivance, see *la base du Système Métrique et la Géodesie* of Mr. Puissant.

125. The improved perpendicular, or mason's level, being more convenient than the spirit level, is made use of to adjust the rod in a horizontal position. The sides A C, A B, are of equal length, and form an isosceles triangle A C B, and are kept in position by the metallic arc *a* E *b*. An alidade C D, carrying a vernier, is suspended from the centre C of the arc, and revolves about it. The arc is divided into degrees, and by the aid of a vernier a minute can be read upon it.

A spirit level *c f* is fixed perpendicularly to the alidade, upon which equal divisions are traced and numbered from the centre, by which it can be seen when the bubble is in the centre. The zero of the graduation of the arc *a b* is also at the centre E of the arc.

The instrument is so constructed that when placed upon a horizontal plane A B, the alidade is at the zero point of the graduation, and the bubble is in the middle of the glass. When it is turned end for end the same conditions should be fulfilled.

Something might be said of the tangent screw attached to the alidade, and other details in the construction of the instrument; but they can be easily imagined. If, however, a more detailed description is desired, it can be found in vol. ii, p. 9, of the *Système Métrique.*

126. As much time is lost in levelling the rods, it is better, when the inclination does not exceed two or three degrees, to leave them as they are, and measure the inclination, and then reduce the rod to the horizon by calculation, that is, calculate its projection on a horizontal plane. The inclination is measured by reading the graduation indicated by the alidade, then turning the level end for end, and reading the indication in this position also. Half the sum of these indications is the inclination of the rod.

127. *The reduction of the rods to the horizon.*—Let C B (fig. 56,) be the rod, C A its horizontal, and A B the vertical projection, and θ the angle of inclination. Knowing A B, and the angle C, we can find the sides C A, A B. The triangle A B C gives C A = C B cos θ. But θ is a very small angle, and the value C A cannot be calculated

with sufficient precision; we therefore obtain it by finding the excess (x) of C B over C A. $x =$ C B—C A; and we have $\cos \theta = 1 - \frac{1}{2}\theta^2$, nearly, from which we get C A = C B $(1 - \frac{1}{2}\theta^2)$ and by calling C B = L, we get $x = \frac{1}{2} L \theta^2$. Now by substituting for the arc θ its value expressed in its number of minutes we have

$$x = -\tfrac{1}{8} L (2\theta)^2 \sin^2 1' = - P L (2\theta)^2.$$

P being substituted for the constant $\frac{1}{8} \sin.^2 1'$. In the same manner we find for the difference in height A B,

$$y = L \sin. \theta = \tfrac{1}{2} L (2\theta) \sin. 1'.$$

The levelling instrument makes known the angle 2θ by turning it end for end, and taking the sum of the inclinations, and the calculations are very easy. The logarithm of the constant P = 8.0243622; and log. $(\frac{1}{2} \sin. 1') = 4.1626961$. The arc (2θ) is expressed by its number of minutes.

The calculation is much abridged by constructing tables giving the values of x and y for every inclination (2θ) of the rod.

128. *Correction for temperature.*—When the rods are metallic the change of temperature in the morning and evening produces a change in the length which must not be neglected. The temperature of the rods is noted at those times when there is the greatest variation, and the mean between these extremes is assumed as that of the rods for the interval which elapses between the two observations. For the purpose of noting these changes a thermometer is sunk in the rods.

In the rods used for the French triangulation the thermometers were metallic, and fitted to a brass rule, which slid lengthwise into the rods, and were held there by two grooves. One of the ends of the rule forming the back of the thermometer was fastened to the rod by a screw, or by soldering, while the other was free. As the metals of the rods and thermometers were different, one being of platinum, and the other brass, their expansion was not the same for the same variation of temperature. At a certain degree of temperature, two marks, one on the rod, and the other on the thermometer, coincided, and they ceased to do so as soon as the temperature changed. By the aid of a magnifying glass, and divisions of equal length marked on the metal, the observer was enabled to read the excess of expansion of one metal over the other, and consequently the variations of temperature. The degrees of temperature were marked on the thermometer, and could be read with facility. The manner of calculating the lengths corresponding to the changes in temperature will presently be explained.

It was important that the rods should be sheltered from the sun, and for this purpose a kind of wooden roof was placed on the levelling

boards, with vertical sights at each end by which the rods were placed in the required direction.

To avoid errors, each reading of the tongue, the metallic thermometer, and of the inclination of the rods, is made twice. The results are noted in two separate books, and compared before proceeding to a new measurement.

129. *The measurement of the rod by the standard.*—To determine the exact length of the rods it is necessary to compare them with some other known length. For this purpose, an instrument called the *comparing rod*, is used, which, by magnifying them, shows the smallest differences in length between two rods placed one on the top of the other, and abutted at one extremity against a fixed point. For a detailed description of this instrument see the *Système Métrique*, vol. iii, p. 464. In obtaining the length of rods by this standard, the nature of their substances, and their temperature, must be taken into consideration.

131. It has been ascertained that for a change of 1° of the centigrade the length of the rod varies a quantity a, shown by the following table.

Platinum, - - -	$\alpha = 0.0000085655$
Brass, - - -	$\alpha = 0.0000187785$
Wrought iron, - -	$\alpha = 0.0000122045$
Steel, not tempered, -	$\alpha = 0.0000107915$

This is called the linear expansion.—Thus a metre of brass, in undergoing a change from 0 to 100°, is increased in length $0.^{m}00187785$, or nearly two millemetres, [0.07874 inches English.) This is a quantity too large to be neglected.

Suppose l to represent the length in metres, toises, feet, &c., of a metallic rod at a given temperature. If the thermometer shows t number of degrees, (centigrade,) we have the elongation for every unit of measure by the proportion $1° : \alpha : t : \alpha t$, α being the elongation for one degree taken from the table. Thus the length corresponding to t degrees is increased $\alpha\, t\, l$, and becomes

$$L = l\,(1 + \alpha t) \quad . \quad . \quad . \quad . \quad (1)$$

131. First Case.—When the rod is of wood, and the standard of metal, we commence by calculating the length L of this standard for the actual temperature, knowing its length l at zero. The number denoting l is usually engraved on the standard. Then if the wooden rod is made of the same length as the standard, L will express its length. If it is not the same length, the difference is shown by means of the apparatus of comparison, and this difference added to, or subtracted from

L, gives its length, which, as we have before observed, is invariable. The number denoting the length is then inscribed on the rod.

Second Case.—If the rod and standard are both of the same metal there is no calculation to be made. If they are also of the same length, l, that of the standard at zero is engraved on the rod. When they are of different lengths, the difference δ is measured by the comparing apparatus, and $l + \delta$ is then the length of the rod at zero. In this case the actual temperature is not considered.

Third Case.—We suppose the rod and the standard of different metals, and cut to the same length at a certain temperature t. When the temperature of the standard is reduced to zero its length becomes l, and the rod becomes of an unknown length x, which it is required to find. By equation (1,) we know in a change of temperature from 0 to t degrees centigrade the length of the standard and the rod will become:

For the standard, - - - $l\,(1+\alpha t)$,
" rod, - - - - $x\,(1+\alpha' t)$

α and α' expressing the linear expansion for a unit of measure in the two metals respectively. As both rods are then equal, we have

$$l\,(1+\alpha t) = x\,(1+\alpha' t)$$

from which we get

$$x = l\left(\frac{1+\alpha t}{1+\alpha' t}\right)$$

By developing this equation, and neglecting the terms of the second order, we have for the length of the rod at zero,

$$x = l\,[1-(\alpha'-\alpha)\,t] \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Its length at any given temperature t' of the centigrade will be

$$l' = x\,(1+\alpha' t') \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

and if the rod is not cut exactly the length of the standard its length will be $x+d$; d being the difference of the two.

This value $x+d$ is the one marked on the rod, and is that given to x in equation (3). When a line is measured with this rod, under a temperature t', given by the centigrade thermometer, it is necessary to calculate its length l' by equation (3), α' being the constant corresponding to the metal used.

132. This method is subject to the inconvenience of giving a value to l' (the length of the rod,) containing a fractional expression, because the length of the standard l is a whole number, (usually four metres.) To reduce this to an expression containing no fractions, it would be necessary to diminish the rod by a quantity equal to $(\alpha-\alpha')\,tl$, and then at zero it would be of the same length l as the standard. But as this diminution would be difficult to make, and as an addition would be impossible, the following expedient is resorted to.

Suppose that the rod and the standard at a given temperature t are of the same length, namely, $L = l(1+\alpha t.)$

When the temperature falls to T, that is to say, decreases t—T, the rod will diminish $L\alpha'(t-T,)$ and its length will be

$$L[1-\alpha'(t-T)] = l(1+\alpha t)(1-\alpha' t+\alpha' T.)$$

Now find what should be the temperature, in order that the rod may be of the same length l as the standard at zero. To do this make the above value equal to l, and by neglecting terms of the second order we have

$$\left.\begin{aligned} \alpha' T &= (\alpha'-\alpha)\, t, \\ T &= \left(\frac{\alpha'-\alpha}{\alpha'}\right) t = \left(1-\frac{\alpha}{\alpha}\right) t \end{aligned}\right\} \quad . \quad . \quad (4)$$

The length of the standard l is then marked on the rod, and also the temperature T, at which the rod assumes this length.

To get the length l' of the rod at any other temperature, equation (3) is used. In this case t' is the excess of the actual temperature over T.

133. Suppose, for example, that the standard is of platinum, and is five metres at zero, and that the rod is of brass, and cut the same length when the thermometer is 100°. We have then $l = 5$, $\alpha'-\alpha = 0{,}000010213$, and the length of the rod at zero will be $x = 4.^{m}99948935$. If we find any inconvenience from making use of this fractional number, ascertain under what temperature the rod is five metres in length. Suppose it to be T = 5°,44, we then mark on the rod five metres and 5°,44. The result, of course, will be the same in either case.

Now suppose we have ascertained a distance to be 2000 times the length of the rod just described, the temperature being 18°, we can find the total distance in two ways, either by making equation (1), $l = 4.^{m}99948935$, $\alpha = 0{,}0000187785$, and $t = 18$, or by taking equation (3) and making $l = 5$, α = the same number, and $t' = 12°,56$, the excess of 18° over T = 5°,44. These methods both give $L = 5.^{m}001179$, thus a base of 2000 times this rod = $10002.^{m}358$. If the rod was taken as five metres, regardless of expansion due to the metal, it is evident that the very considerable error of $2.^{m}358$ would be committed in the measurement of this distance.

134. *The reduction of a broken base to a right line.*—It is desirable always that the base should be one unbroken right line; but it is not always that ground can be found running in a direct line, and nearly horizontal, for a distance of some 10,000 metres. We are then obliged to measure the length indirectly. This was the case in the measurement of the bases of Melun and Perpignan.

Suppose A B C to represent the broken line, or base, and that we know the lengths A C, C B, and the angle θ = 180°—C, which we

suppose to be nearly 180°. θ = B C 1, and making A C $= b$, B C $= a$, it is required to find A B $= c$, which is to be regarded as the measured base. We have*

$$c^2 = a^2 + b^2 + 2\,ab \cos.\,\theta$$

and by making cos. $\theta = 1 - \frac{1}{2}\,\theta^2$, neglecting the fourth powers of θ we have

$$c^2 = (a+b)^2 - ab\,\theta^2,\ c = (a+b)\left[1 - \frac{ab\,\theta^2}{(a \times b)^2}\right]^{\frac{1}{2}}$$

and by developing the power $\frac{1}{2}$ as far as the terms of the second degree, and designating by θ the number of minutes in this arc, we have

$$c = a + b - \frac{ab\,\theta^2 \sin.^2 1'}{2\,(a+b).}$$

When the signal at B cannot be seen from A, and the signal C can be, it is necessary to know the angle A, as the neighbouring points which are measured in relation to A C should be referred to the base A B.

We have $\dfrac{\sin.\,A}{\sin.\,\theta} = \dfrac{a}{c}$, and $\sin.\,\theta = \theta - \frac{1}{6}\,\theta^3$

from which we get

$$\sin.\,A = \frac{a\,\theta}{c}\left(1 - \tfrac{1}{6}\,\theta^2\right)$$

and by substituting for c its value given above, we have

$$\sin.\,A = \frac{a\,\theta}{a+b}\left[1 + \frac{ab - a^2 - b^2}{6\,(a+b)^2}\,\theta^2\right]$$

Now (see trigonometry,) arc A = sin. A + $\frac{1}{6}$ sin.^{3} A, and substituting for sin. A its value, and then changing the small arcs A and θ into A sin. 1′ and θ' sin. 1′ to express them in minutes, we have

$$A = \frac{a\,\theta}{a+b} + \frac{ab\,(a-b)\,\theta^3 \sin.^2 1'}{6\,(a+b)^3} \quad \ldots\ldots \quad (6)$$

135. *Reduction to the level of the sea.*—The difference between the elevation of the two extremities of the base are known by calculation, and if we suppose the base to be turned about its middle point until one end is depressed as much as the other is raised, the base may be regarded as an arc of a circle with slight curvature, having its centre at the centre of the earth. Suppose A A′ is this arc = B, the length of which is known; and that $a\ a'$ is the concentric arc described on the level of the sea: Ca = K the terrestrial radius, or the normal

* The triangle A B C is spherical, but is reduced to a right line triangle by subtracting from the observed angle C the third of the spherical excess, and taking the remainder for the value of C. In fact, a base is a line of double curvature, but we consider the earth as spherical, and the arc as being that of a circle contained in a vert cal plane. The error from this supposition is inappreciable.

to the surface, $Aa = h$ the height of the extremities of the base above the level of the sea.

It is required to find the arc $a\,a' = b$, which is the base B reduced to the level of the sea. The plexus of geodesic triangles is projected on the surface of this level, and it is therefore necessary to project the base upon it also. The length B is, in fact, measured upon the arc of a circle, because the horizontal direction, perpendicular to the normal, is constantly preserved either by mechanical means or by calculation. The manner of obtaining the height $Aa = h$ will soon be shown; it is the elevation of the middle point of the base above the sea.

We have the proportion $C\,A : Ca : A\,A' : a\,a' = b$

$$b = \frac{B\,R}{R + h} = B\left(1 - \frac{h}{R^2} + \frac{h^2}{R^2} - \&c. \;.\;.\right);$$

as R exceeds six millions of metres, (nearly seven millions of yards,) and as h is always very small the series is converging, and we can, in almost every case, take the two first terms $B - \frac{Bh}{R}$. Thus to reduce the base to the level of the sea it is necessary to subtract $\frac{Bh}{R}$.

136. We have now given an account of the operations and calculations necessary to obtain a geodesic base. It is the most delicate of all geodesic operations, as the accuracy of all other results depends upon it. The utmost care is therefore necessary in all the details of its measurement. To give an example of the great accuracy it is possible to attain, we will instance the measurement of the bases of Melun and Perpignan, measured by Delambre and Méchain, the first near the road from Paris to Melun, and the other from Vernet to Salces.

The base of Melun, after the corrections were made, and it was reduced to the level of the sea, was found to be 6075,90 toises; and that of Perpignan 6006,249 toises.

The distance between these bases was considerable, and they were connected by a chain of sixty-three triangles of the first order. By the aid of formulas, which will be given hereafter, one of these bases was calculated from the other, and the result was as follows:

Base of Perpignan, measured, was	6006.249	(13135.6665 yds. Eng.)
" " calculated,	6006.089	
Difference,	0.160	

Thus the error is only 0,16 of a toise, or 11.52 inches, (12.55 inches English,) a quantity scarcely worth noticing. This coincidence, however, is no doubt attributable to the compensation of errors, as the

chain of triangles from Orleans to Bourges was found defective in the verification it was subjected to when the chain for the *meridian* of Fontainbleau was measured. The error was confirmed by another lateral line to the west of the first.

These results, then, are not cited to show their exactness, but rather as examples of the care necessary to be taken.

Seven bases have been measured in France, and compared with each other, by connecting them with a chain of triangles. The results will be given hereafter. The errors are so small that they may be attributed to causes which will be assigned hereafter, rather than to the imperfection of the operations themselves. These magnificent works are in the highest degree honourable to the able engineers entrusted with their execution. For a comparison of the base measured on the Bordeaux Heaths, with that measured by Oriani, near the Tession, see the *Nouvelle Description Géométrique de la France, p.* 458.

TO BE CONTINUED.

Notes on Belgium. By Captain G. W. Hughes, *United States Topographical Engineer. Addressed to* Francis Markoe, Jr., Esq., *Corresponding Secretary of the National Institution, Washington.*

[CONTINUED FROM PAGE 232.]

Our next visit was to Fontaine l'Eveque, about seven miles from Charleroi, up the Sambre, the seat of the nail factories of the Province of Hainault. There are about 5000 persons employed (during the winter,) in the fabrication of nails; but not more than forty of this number are connected with the machines, all the others being occupied in forging nails by hand. The machines used here are an American invention, and exact copies of Judge Pierson's, which may be seen in operation at the Ramapo works, New York.

It requires much better iron for cut than for wrought nails, and it is asserted that, as it regards the larger sized nails, the iron plates, adapted to the machine, cost more than the same weight of wrought nails. This will explain the reason why so many persons are engaged in the slow operation of forging them by hand. It must also be remembered that wages are extremely low, and that, of course, labour-saving machinery is less important in Belgium than in most other countries. An agricultural labourer receives only 1fr. 10 centimes a day, or about twenty cents of our money, and finds his own subsistence. When the severity of winter drives these people from the fields they engage in nail making, at probably no higher rates of wages.

The "Clouterie à la Mecanique," or manufactory of nails by machinery, also belongs to an anonymous company, under the patronage of a bank, and is in charge of a director, Mr. D'Haussy, by whom we were most kindly entertained. It consists of thirty machines, making as many different sized nails, put in motion by an engine of thirty horses power, which is competent to the working of sixty machines, the whole number of which the director calculates will be soon put in operation. Each machine makes 120 nails per minute, every revolution cutting and heading one nail. It requires no other attendance than simply *feeding* it with iron, which it seems to *eat* with as much avidity and gout as an anaconda exhibits in gorging its prey. There is, however, another American nail machine, far superior to the one now in use, which makes a better nail, and cuts, it is said, from 600 to 1000 per minute. It is called "Hunt's Patent," after the inventor, an ingenious mechanic of New York.

There are something more than 12,000 tons of nails fabricated annually in Belgium; of which about one-fourth part are exported.

The following extracts from the printed tariff of prices will show their sizes, prices, &c.

No. of thousands to the ounce.	Price per thousand	Price per kilogramme.	
		Dollars.	Cents.
3	30 centimes.	3	42
6	34 "	1	93
12	42 "	1	19
16	48 "	1	04
32	71 "	0	75
96		0	56

The next day we turned our attention to the glass and chemical works at Oignies, about nine miles from Charleroi, on the road to Fleurus and Ligny. This establishment occupies the buildings and former site of Oignies, a Monastery of learned Augustine Monks, which was suppressed by the French revolutionary army, and the property confiscated to the state. Very extensive buildings have been added to the old monastery, and these works now cover an area of thirteen English acres. They belong to an anonymous society,

with a capital of 10,000,000 francs, under the patronage of the *Societé générale de Belgique.*

Mr. Kemlin, the highly intelligent director, conducted us over these works, and was at much pains to show, and to explain to us, even the minutest details connected with this vast establishment.

The director led us first to the chemical department, which may be regarded as a grand laboratory, where operations are carried on, almost, on the scale of nature. Our attention was drawn to the formation of sulphuric acid in the large way. The first process is to procure the sulphur, which is obtained from iron pyrites, a material sufficiently abundant in most coal measures. This mineral, or *mundic,* as the British miners call sulphuret of iron, is washed, ground to powder, and dried. It is then put into furnaces, and the sulphur, expelled by heat, is conducted into large leaden chambers. During its transit it combines with oxygen, forming the sub-acid or sulphurous acid gas. To still further oxygenate it nitric acid is used. This is liberated from the nitrate of potash, and passed into the leaden chambers at the same time with the sulphurous acid, by which it is decomposed—the oxygen uniting with the sulphurous acid forming sulphuric acid, and the nitrogen escaping free.* The sulphuric acid is then passed through several leaden chambers containing water, by which it is absorbed. 2,000,000 kilogrammes, or more than 4,000,000 lbs. of this acid are made here annually; and it sells for $4 the French quintal, (of 100 kilogrammes,) which is the usual measure of sale, and is equal to 220½ lbs. English.

We next saw the manufactory of sulphate of soda. It is obtained from a substance called *marine salt,* (which term, I understood from the director, is applied to a mixture of the sulphates and muriates of soda, separated from the other salts contained in sea water.) This article is admitted free of duty, at the Custom House, but is *poisoned* to prevent its use for domestic purposes. This salt is placed in a furnace, and the muriatic acid is expelled in a gaseous form, and passed through a great number of large earthen retorts connected together with bent tubes of the same material. These retorts are partly filled with water, which absorbs the gaseous acid, forming hydrochloric acid. Of this there is made annually about 500,000 kilogrammes, or 1,100,000 lbs., which sells for about fifty cents the 100 lbs. A portion of it is passed over quick lime, forming the chloride of calcium.

The sub-carbonate of soda, so much employed in soap and glass making, is formed by taking a mixture of sulphate of soda, carbonate of lime and charcoal, and calcining them together in a furnace. During the calcination a double decomposition takes place, and the pro-

* It is necessary to remind our readers that the theory of the formation of sulpuric acid is by no means so simple as is here supposed.—Com. Pub.

ducts are a mixture of sulphate of lime, (insoluble,) and sub-carbonate of soda, (soluble.) These substances are separated by the action of water, which takes up the soda and leaves the lime. This residuum is used as a manure. The solution is now boiled down, and the salt obtained in a crude form. It is then again dissolved, evaporated by boiling, and kiln dried, forming the ordinary sub-carbonate of soda of commerce. When it is desirable to obtain it of a very pure character it is once more dissolved, and then left in vats to crystalize, on strings placed in the fluid for the purpose.

A portion of this salt is sold, and the rest is employed in the glass works. The annual production is about 2,000,000 lbs., and it sells for $6 50 cents the 110 lbs., or $13 the French quintal.

There are 250 persons employed in this department; the men receive two and a half francs a day, and the women and boys from seventy-five centimes to one franc a day.

Our next visit was to the glass works—they are exclusively devoted to the fabrication of looking glasses and very large plate, window and door glass, of the better quality.

Glass is made from the fusion of a mixture of sub-carbonate of soda and sand. The sand is very nearly pure silex, as white as snow, and very fine. It is brought from the Ardennes, where it occurs in beds forty feet thick. It is worth from one and a half to two and a half francs the French quintal, or 220½ lbs. English. It is washed, to separate the earthy matter from it, and kiln dried.

The proportions of sub-carbonate of soda and clean sand, entering into the composition of glass, are variable, depending on the quality of the former. When it is very good, the mixture is *one part* soda and *three parts* sand—when inferior, it is mixed with equal quantities of sand. This mixture is melted in furnaces, somewhat resembling, in appearance, blast furnaces, but not so large. Coal is used as the fuel. In furnaces of the most approved form the mixture may be fused in fifteen hours, but in others it requires, for this operation, twenty-four hours. The broken fragments and clippings of glass are re-melted.

The melted glass is run into large argillaceous tubs, by which it is conveyed to an iron table, about twelve feet long and seven feet broad, on which it is poured; and while still soft, an iron roller, about one foot in diameter, is repeatedly passed over it. As soon as the plate becomes solid it is placed to cool slowly, in a low, flat, arched receptacle, which is closed up, and the plate is left here twenty-four hours. When taken out, it is scarcely translucent, and seems to be covered with large, slightly convex blisters, and its edges are uneven, and sometimes defective, for several inches in width.

The tub by which the melted matter is carried from the furnace to the table is called a *cuvette*, and is made from a dark blue clay, found near at hand. This clay is nearly pure alumine, and when baked by a slow fire, (after having been prepared for the purpose by washing, grinding, etc. etc.,) it is sufficiently hard to strike fire from steel.

The crude plate is now carried to the rough polishing house. In this house are eight large smoothly-polished marble slabs, each rather larger than the iron table, solidly laid in mortar, on brick foundations. These slabs are covered with a gypseous paste, and the glass plate, fastened to an iron frame moved by steam, is ground on the marble by a species of circularly rubbing motion. Presently it is fixed to the slab, and its upper surface is rubbed in a similar manner. It is then transferred to other slabs, where two slabs are ground together by machinery, with fine sand between them, and jets of water continually playing on them. Next they are ground, in the same way, with emery instead of sand, till their surfaces are nearly uniformly smooth. They are now carried to another house, where they are ground together by hand, with nothing between them, till they are perfectly smooth. They are then fixed on a table to be polished. The polishers are made of coarse felt, fastened to iron frames, moved by steam. The substance used for this purpose is a *crocus*, obtained from an ochrey red oxide of iron. After being rubbed on both surfaces till it is supposed the plates are perfectly polished, they are removed to the finishing room, where they are carefully rubbed by hand, for the last time, with crocus.

The next operation is the cutting of the glass to the required dimensions, (for it is always cast large.) This is done with a diamond, and a single line, seeming scarcely to penetrate the surface, is sufficient even for the thickest glass. A slight, quick blow, from below, completely separates the parts, leaving the edges perfectly smooth.

The finishing process for mirrors consists in the application of the amalgam. As much mercury is poured on the table as the tin leaf can be made to take up, and the glass is then forced over the amalgam, beginning with one edge, and removes before it the surplus mercury. This requires some care and skill, especially with a large glass. The director is making arrangements to cast a plate (for a mirror, to be exposed at the coming "exhibition of industry," at Brussels,) the size of the iron table recently cast for that purpose at Couillet. The price of this large mirror will be, according to the tariff, some $2,500. The largest which has, as yet, been sold at these works brought 9,835 francs. It was 150 inches × 100 inches. It would require eight days to finish one of these very large glasses if they should work on it uninterruptedly for that period.

One hundred and fifty persons are employed in this branch of the establishment, and arrangements are being made to enlarge the buildings, and increase the number of employees, as a ready sale is found for all the glass they can make. The only difficulty is to secure the services of skilful workmen; who can earn from five to seven francs a day, (very high wages,) according to their knowledge and industry.

The Sambre passes directly under the walls of Oignies, and affords a convenient communication with Charleroi and Namur. It is called "*une riviere canalisé*," or a *canal-ized* river, which expresses the meaning much better than our term "slack water navigation;" and might be adopted into our language with some advantage.

In company with Mr. Meeas we visited a manufactory of sugar, from the beet root, belonging to a company called the *Raffinerie Nationale,* of which he is the president. The estate of this association consists of three large farms of 1,800 acres of rich land, and is devoted, primarily, to the cultivation of the sugar beet, but the corn is also grown, in order to preserve a certain alternation of crops. In connection with this main object they raise large numbers of stock, which are fed on the pulp after the saccharine matter has been expressed, and this yields no small amount of their dividends. The farms are kept in admirable order, and the buildings are very extensive, well arranged, and well built. Order and good management seem to reign everywhere under the admirable administration of its enterprising president.

The capital of the company is 4,000,000 of francs paid in, together with the application of the dividend, for the last two years, to the improvement of the works.

The annual production of sugar and gin is sold for about 200,000 francs. The wholesale price of sugar is eighty francs the French quintal, (of 100 kilogrammes,) and of gin, fifty-six centimes the litre, (about three pints English.)

The average crop, in good seasons, is about 14,000 kilogrammes, or fourteen tons English to the acre, which is worth sixteen francs the ton, or about $44. The root, most in favour, is the Siberian, which requires a rich sandy loam, and a good deal of moisture, but the labour, per acre, is much less than that usually expended on the cultivation of tobacco.

It is said that the beet root possesses rather more saccharine principle than the same weight of cane; but thrifty housewives say that the sugar from it will not *go so far* for domestic use; and it is not so good for the preservation of *fruit*, as it causes the *sweet meats* to ferment.

The refinery is situated between Waterloo and Mont St. Jean, to

the left of the road to Quatre Bras. The buildings of this establishment cover some ten acres of ground, and are exceedingly well arranged. We were taken through every portion of it, and spent nearly the whole day in its examination; but as the subject is one that cannot be disposed of in the short limits of a paper, I shall not attempt the subject at present.

This estate extends to "the field of Waterloo;" and from the refinery we had a magnificent view of the lofty *lion monument*, which marks the spot where the Prince of Orange was wounded. In looking round on the soft landscape, the peaceful villages, and the fields rich with waving corn, I could not but recall to memory the beautiful and touching lines of Southey, so descriptive of the effect produced on my own mind in contrasting the fury of the battle with the air of repose which seems to pervade the locale of that bloody strife.

> "Was it a soothing or a mournful thought,
> Amid this scene of slaughter as we stood,
> Where armies had with recent fury fought,
> To mark how gentle Nature still pursued
> Her quiet course, as if she took no care
> For what her noblest works had suffered there."

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Cast Iron Rails for Railways. By Ellwood Morris, *Civil Engineer.*

We are informed in Wood's treatise upon railroads, that in the early part of the seventeenth century, railroads were first used in England, and they were then formed of wood; *the wooden rails* were employed for about 100 years, when in 1767, *cast iron rails* were first introduced, and thereafter continued for a period of near fifty years, to be used instead of any other material; but in the year 1815 *malleable iron edge rails* were devised, and after Mr. Birkenshaw, in 1820, had obtained his patent for an improvement in the form of such rails, and applied the rolling mill to their manufacture, they were very extensively adopted, and subsequent to that period of time have been almost exclusively used; indeed, since the modern improvements in the means of intercommunication by railways have enabled locomotive steam engines to travel at velocities of thirty miles and more, per hour, the use of *cast iron rails* has been, for the present, laid aside, if not wholly abandoned, on public railways.

The chief reasons which seem to have induced engineers, both here and abroad, so much to prefer *malleable* before *cast iron rails*, as to exclude the latter from use, appear to have been, originally, a belief that,

1. Malleable iron rails were cheaper than those of cast iron.

2. Malleable iron rails being made in longer lengths caused fewer joints.

3. Malleable iron rails were less liable to fracture from concussion.

4. Malleable iron rails were thought to be somewhat more durable.

Although these reasons are very plausible they have nevertheless been found not to be valid in practice to the full extent that was anticipated by those who fostered them, and with regard to them it may be observed,

I. With respect to the comparative economy of cast and malleable iron rails, it is certain that the latter, in this country at least, are not cheaper than the former, and if made of American rolled iron instead of imported, they would be much more costly.

II. Convenience of handling seems to have fixed the length of wrought iron rails at about fifteen feet, and of this dimension there is but little difficulty either in moulding or casting rails; but it is very questionable whether sufficient practical advantages do not attend cast iron rails of six or ten feet length, to induce a preference to be given to them over others of greater lineal extent.

III. It is unquestionably true that *malleable iron rails* are far stronger than *cast iron* ones of the same dimensions, when exposed to *a direct impulsive force;* indeed, we find it stated in Tredgold's essay on the strength of metals, "that a velocity, (direct,) of $17\frac{6}{10}$ feet per second, or twelve miles per hour, would break a beam (of cast iron;) or a beam would break by falling from a height of five feet!"

Now if any such force was actually brought to bear upon the rails of railways in practice, it would, of course, be improper to employ those of cast iron, but happily this is rarely, if ever the case, for although Tredgold's statement may be true, when a weight *falls directly* upon a cast iron beam; no such result would ensue from *oblique impact,* with the same momentum that would be generated in the supposed case; and as the concussions produced upon a railway by a train at speed are of the latter character, it becomes necessary to inquire what vertical stress, or pressure, imposed by the wheels, results from their *oblique impact* when in rapid motion upon the rails?

A little reflection will satisfy any one that the impact upon the rail of a carriage wheel running at high speed, is a very different affair from the concussion produced by a weight falling freely; for instance, if an engine with a velocity of thirty miles an hour passes over a rail which, at the joint, is $\frac{1}{10}$ of an inch higher than its neighbour, the wheel would advance in the air without touching the rail for the space of *one foot;* for, by gravity, "a body requires $\frac{1}{44}$ of a second to fall $\frac{1}{10}$ of an inch, and in that space of time a wheel running at the

rate of thirty miles an hour would move horizontally forward *one foot;*" in such a case, then, the wheel may be regarded as having traversed in the air an inclined plane, of which the base would be 120 times the altitude, and consequently if the force of impact be resolved by the parallelogram of forces, into two others, one perpendicular to the rail, and the other parallel to it, the former will be not quite the $\frac{1}{120}$th part of the whole impulsive force, instead of being equal to it, as would have been the case if the stroke were direct, or if the engine had fallen freely by the action of gravity alone through the vertical space of $\frac{1}{10}$th of an inch, and the percussive force upon the rail, produced by a free fall through even that small height, would far surpass that which would be created by the $\frac{1}{120}$th part of the oblique momentum of the wheel at the pace of thirty miles an hour.

This reasoning leads us to the conclusion that in such cases the greater the velocity of the engine the less will be the vertical pressure of the wheel upon the rail, and this, to a certain extent, is undoubtedly true, for the horizontal component of the force of impact will be greater than the perpendicular one, just as the velocity is greater.

Upon the same principle it is, that a musket ball shot parallel along a horizontal plane, so as to barely touch it tangentially, will not press upon the plane at all within the limits of its level or point blank range.

Whether these views agree or not, with those commonly entertained concerning fast trains on railways, they are, nevertheless, legitimate deductions from the established doctrine of forces, and serve to account for the small effect produced by the ordinary inequalities of a railroad, as shown in the results displayed by the following direct experiments touching this matter, which were made by Professor Barlow, and recorded in his work on the "strength of materials," English edition, 1837; these experiments are conclusive in their character, and establish, beyond question, the fact, *that the vertical stress imposed upon a railway by the transit of locomotive engines at velocities varying from twenty-two to thirty-two miles an hour, is but little, if any, in excess of that produced by a quiescent load of the same weight!*

These experiments by Professor Barlow, were made with an ingenious and accurate instrument, to determine the deflection of rails under trains running at high speed, and as the deflection of materials under a strain, is as the insistent weight, the vertical pressure upon the rails is by this means accurately indicated.

Experiments.

		Deflection in inches of the rail in the middle length.
1. Speedwell engine and train at twenty miles an hour, weight upon the driving wheels nearly six tons, or three tons on each wheel. - - - -	=	.0425 .0400 .0400
2. Ditto same speed, - - - -	=	.0320 .0400 .0420
3. Ditto very slow, - - - -	=	.0240 .0250 .0320
		9).3175

Mean deflection in these experiments, inclusive of the yielding of the stone block supports, - = .0353

Now, by trials made with direct pressure, upon the same railway bars which were travelled over by the trains in the above experiments, and then taken up and forwarded to Woolwich, for the purpose of examination, Professor Barlow states that the mean deflection, under a load of three tons weight at rest, was - - = .0314

Whilst the mean deflection, under trains in motion, at velocities as high as twenty miles per hour, as stated above, amounted to - - - - = .0353

Difference, - = .0039

which, when we consider that a portion of this difference is due to the depression of the blocks, indicates "a close agreement, which shows, that when every thing is well fixed and secure, the deflexion, and consequently the strain, is nearly the same, whether the load be *in motion or at rest;* and that each rail is only pressed with half the weight on one pair of wheels."

The rail tried in the preceding experiments, was that of the Grand Junction Railway, weighing sixty-two pounds per yard, and laid with three feet nine inches bearing; in those following, Professor Barlow employed the same pattern of rail, but laid with bearings five feet asunder.

Experiments.

		Deflection in inches of the rail in the middle length.
1. Swiftsure engine, velocity twenty-two miles an hour, three tons weight on each driving wheel, -	=	.093 .077 .080

2. Ditto same speed, - - - - $= \left\{ \begin{array}{l} .082 \\ .070 \\ .077 \end{array} \right.$

3. Speedwell engine, velocity thirty miles an hour, $= \left\{ \begin{array}{l} .112 \\ .091 \end{array} \right.$

4. Ditto, velocity thirty-two miles an hour, $= \left\{ \begin{array}{l} .122 \\ .115 \end{array} \right.$

5. Fury train, velocity twenty-three miles an hour, $= \left\{ \begin{array}{l} .083 \\ .085 \end{array} \right.$

12)1.087

Mean of these experiments, inclusive of the yielding of the stone block supports, - - - = .090

In experiments made at Woolwich, with vertical weights at rest, upon the same rails, the mean deflection produced at five feet bearing by a quiescent load of three tons, was - - = .079

And the mean deflection found above, with three tons on a wheel in motion, at rates from twenty-two to thirty-two miles an hour, - - - = .090

Difference, part of which is owing to the depression of the blocks, - - - - - = .011

Upon the whole series of these experiments, Professor Barlow observes that "nothing can be expected much more satisfactory, as it is thus proved, *independently of any opinion,* that while the blocks and fixings are secure, the strain from a passing load is but little in excess of that from a quiescent load."

The above quotations, demonstrating as they do distinctly, that the vertical stress of trains at speed, surpasses so little the effect of quiescent loads of the same weight, (*that it is only necessary to proportion the rails of railroads to resist quiescent, and not concussive forces,*) change the whole face of the question between *cast and wrought iron rails;* they strike away all the objections heretofore urged against the brittleness of cast iron, for it does not admit of doubt, that a beam of that material, of suitable proportions, is quite as competent to carry a quiescent load as is one of malleable iron; again, a cast iron rail will yield sufficiently to impact, and return to its proper level the moment it is relieved of the weight of a train, for it is well known that its elasticity and power of restoration, after deflection, is within certain limits so perfect, that owing to its regularity in that respect it was even proposed by Tredgold to use beams of cast iron as weighing machines, measuring the weights imposed by the deflections produced!

In view of the conclusive arguments of Professor Barlow upon the relative effect of passing and quiescent loads upon railways, we may limit our researches to ascertaining simply the dimensions of a cast iron rail, *which shall have the same surplus strength to resist a quiescent load equal to the maximum weight upon one wheel, as is found in practice to be necessary in a malleable iron rail;* to aid us in this matter we shall again recur to the valuable work from which we have already quoted so much, and upon pages 428 and 430 these statements will be found; that when the road is in good order "the rail is only deflected at the greatest velocity, a little more than is due to a quiescent load, equal to half the weight on two wheels; but that in consequence of imperfections a strain is occasionally thrown on the rail which produces a deflection about double that which belongs to the load in question." And as a consequence of this, results the "experimental fact that with engines of twelve tons weight, (and three tons on a wheel,) running at velocities not exceeding thirty-two or thirty-five miles per hour, *it is not necessary*, even as railways have been hitherto constructed, to provide for a strain of more than seven tons, which is allowing a surplus strength of sixteen per cent. beyond the double of the mean strain," and this was experimentally found to be a strength amply sufficient to resist the lurching of locomotive engines running at high speed. Tredgold, on the strength of metals, informs us that compared with *cast iron as unity*, the strength of *malleable iron* is $1\frac{12}{100}$ times, and its stiffness $1\frac{3}{10}$ times.

Now as the stiffness of rails is a matter of such importance as to be almost the controling desideratum upon railroads, having, in fact, induced the preference given to parallel over fish-bellied rails, it would, perhaps, be proper so to proportion cast iron rails that they may be *as stiff* as those of malleable iron of suitable strength; hence in the case of a railway destined to carry at a high speed locomotive engines of twelve tons weight, and running three tons upon a wheel, as assumed by Professor Barlow, if *a wrought iron rail* possessing an elastic strength of seven tons* is sufficient, *a cast iron one* to have the same stiffness should be proportioned to resist a vertical weight of nine tons, for supposing the stiffness to be as the weights imposed, and the comparative flexibility of the two materials, we have

* The necessity of proportioning rails to resist strains so much greater than is really produced upon a way in accurate adjustment, arises chiefly from an unequal settlement taking place in the two lines of rails, producing that lurching of carriages which sometimes doubles the weight upon a wheel; now, if in all cuttings, and upon all well consolidated embankments, both lines of rails were laid upon *a continuous bed of concrete*, of sufficient depth and width, it would be impossible for the rails to settle irregularly, and if they subsided at all, it would be so equally as to preserve still the proper relation to each other.

1 : 1.3 : : 7 : 9.1, which would give an excess of strength to the cast iron rail in the ratio of $1\frac{3}{10}$ to $1\frac{12}{100}$.

Therefore it will be perfectly safe to assume, as the proper size for *cast iron rails*, sufficient dimensions to give them such a transverse section, as with the fixed length of bearing, will furnish a strength equal to *three times the maximum weight designed to be imposed upon any wheel*, and this is precisely the same conclusion as is arrived at by Mr. Wood, in his valuable treatise on railways, third edition, page 130.

The proportions proper for the section of a cast iron rail may be readily ascertained, either by the formula of Tredgold, which give an excess of strength, and the accuracy of which, up to the limit of perfect elasticity, has lately received ample confirmation;* or the section may be more conveniently determined by the accurate rules given by Professor Barlow, for malleable iron rails, as quoted in the third edition of Wood on Railroads, allowing for the difference between the two materials in the ratio of 1 to $1\frac{3}{10}$.

If, notwithstanding all that has above been said concerning the capacity of cast iron rails to endure successfully the strains which really exist in railway practice, fears should still be entertained of their sudden fracture under trains at speed, all such fears may be completely nullified, by casting in the centre of the head, or top table of the rail, a rod of malleable iron of about a half an inch in diameter, as has already been done with success in cast iron wheels,† to prevent an immediate separation of the fragments in case of sudden breakage; and in addition to subserving its purpose effectually, the wrought iron rod would improve the chill of the head of the cast iron rail to an adamantine hardness.

These observations apply especially to rails supported at intervals only, as is now the usual practice; but if the plan of *continuous bearings*‡ should be generally adopted in railways, the propriety of which has been strongly urged by English engineers, (see an able paper by J. Reynolds, Esq., Civil Engineer, recorded in the second volume Trans. Inst. Civ. Eng.,) as a perfect remedy for acknowledged defects, and which method has been used with success by Mr. Brunel upon the Great Western Railway; *all objections against cast iron rails must wholly vanish;* and with regard to railways of continuous bear-

* See experiments on the strength of cast iron, by Francis Bramah, Civil Engineer, in the second volume Trans. Inst. Civ. Eng.

† At the works of the New Castle, (Del.) Manufacturing Company, and also at other places; by this operation the strength of wheels is very materially augmented.

‡ The tendency of the extensive practice which has now been had on railways is certainly establishing gradually in the minds of engineers a conviction of the superiority of roads of continuous bearing laid with the U, or bridge rail, over those of any other construction.

ing, if the preservative processes now applied to timber should fully answer their intended purpose, without too much expense, as now seems highly probable, it cannot be questioned, that if laid upon Herron's patent trellis plan, or in some other mode, which, with continuous bearing, furnishes also the requisite solidity of foundation, and strength of lateral tie, such roads will possess unquestionable advantages over those laid with isolated supports.

There is another very important fact developed by the judicious experiments of Professor Barlow, which demands the attention of engineers in all subsequent railways, (particularly if they are not of continuous bearing,) whether laid with cast, or malleable iron; and that is, that if rails are supported by isolated bearings at *uniform* distances asunder, *they deflect unequally between the supports when traversed by the trains;* the joint lengths are the most flexible, and consequently, in order that the railway may be equally stiff in every part, the rails must either be made of greater size in the joint bearings, or else the supports at the joint ends must be brought nearer together, in the same proportion as the deflection of the joint length beneath a passing train is greater.

Professor Barlow found by experiments made with his accurate deflectometer, that the heavy rails of the Grand Junction Railway, laid with uniform bearings, deflected under trains running at velocities as high as thirty-two miles an hour, .121 in the joint lengths, when in the middle lengths the deflection was only .090 of an inch.

Consequently, if the rails are of such length as to span *more than two spaces*, and if one of the middle bearings, or spaces, be assumed $= x$, then the joint bearing, if the rail has every where the same transverse section, must be made $= \sqrt[3]{\frac{.090}{.121} x^3}$, or $\sqrt[3]{\frac{3}{4} x^3}$, because the deflection is as the cube of the bearing length; thus if the strength of a rail be calculated for bearings of three feet, and that distance be assumed for the central lengths between the supports, the joint lengths to make the rail equally stiff throughout must be

$$\sqrt[3]{27 \times \frac{.090}{.121}} = 2\tfrac{7}{10} \text{ feet.*}$$

The principle that the deflections of rails of the same section are *as the cubes of their bearing lengths,* obtains, as a matter of course, in the case of trains at speed; thus in the experiments heretofore cited, the deflection of the Grand Junction rails, with three and three quarter feet bearing, was found by the deflectometer to be 0.353; consequently

* The system of spacing the bearings unequally has been observed by those able Civil Engineers, Messrs. Knight and Latrobe, in planning the new track recently laid upon the Baltimore and Ohio Railroad.

the same rails, at five feet bearing, under trains of the same weight, ought to have deflected $\frac{.0353 \times (5)^3}{(3\frac{3}{4})^3} = .084$, the actual deflection found by experiment was .090 — a sufficiently near coincidence.

IV. On the subject of the comparative durability of wrought and cast iron rails, the experiments are not entirely decisive, but they certainly appear to incline in favour of those of malleable iron;* although it must be remarked that the exfoliation and separation into laminæ, which, owing to the mode of manufacture, it was originally anticipated, would occur to wrought iron rails, when traveled by locomotives at high speed, and the existence of which was formerly most pointedly denied, *does actually take place*, as may be witnessed upon most of our railroads which have been long subjected to the action of heavy trains and high velocities; upon such we may perceive not only exfoliations on the rails, but also that in some instances the sides of the heads have been forced into laminæ, and almost, or acactually crushed off; it cannot be doubted that all such disruptions of the material facilitate oxidation and wear, and, therefore, if due weight is given to this cause of deterioration, which was not formerly taken into the account of decay of wrought iron railways, there seems to be reason for the belief, that under the action of a weighty traffic, cast iron rails may reasonably be expected to endure quite as long, if not longer, than those of malleable iron, especially if the former have their heads, or top tables, properly *chill cast*, which ought certainly to be done; it must also be recollected that if from wear, breakage, or any other cause, it becomes necessary to substitute new rails, the old cast iron ones would be worth at the foundries, almost the price of pig metal.

General Remarks.

The introduction of the hot blast, by enabling the ores of iron to be smelted direct with raw bituminous coal, and the recent application of anthracite to the same purpose, rendered successful by the same means, has, in consequence of the diminished cost of cast iron in the coal basins, drawn the attention of enterprizing practical men in this country, to the propriety of employing cast iron rails, instead of those made either of wood plated with wrought iron, or wholly of the latter material.

At the Lonaconing works in Alleghany county, Maryland, cast iron train rails, with an upright ledge, of the usual form, are wholly used for the service of the coal and iron mines.

The writer is indebted to J. H. Alexander, Esq., Civil Engineer,

* See Wood on Railroads, third edition, page 133 and 729.

and Topographical Engineer of the State of Maryland, for the following information respecting the rails cast and used at those works.

1. The Lonaconing rails are of the common tram pattern, of three and a half inches base, and two and three quarter inches height; they are a little heavier at the joints than in the middle; the length of each rail is three and three quarters feet, the weight, forty-five pounds, or thirty-six pounds per yard lineal; for the curves, which are usually of ten feet radius within the mines, separate patterns are used in casting the rails.

2. Some of the rails were cast direct from the ore, and had the furnace continued in blast all would have been.

3. The hot blast was used in casting the greater part of the rails from the cupola, and altogether with those from the blast furnace.

4. There was no difficulty attending either moulding or casting the rails.

5. Intermediate between the ends which rested on a cross tie, there was placed out of doors a block of wood, but within the mines, slate was packed under the rails instead.

6. One hundred and ten tons of rails of the above pattern were laid.

7. These rails are valued at the furnace at $ 40 per ton by the quantity.

8. The cars run upon these rails carried one ton, or one-quarter of a ton on each wheel, besides the weight of the car.

Mr. Alexander further observes, that from their experience at Lonaconing, he has "no doubt of the useful application of cast iron to larger works, and accordingly the plan of the railroad designed to connect the Lonaconing mines with the Potomac river, rests, in part, upon the adoption of that material."

Since iron has been made in Schuylkill county, in this State, by using anthracite as the fuel for reducing the ore, cast iron rails have been substituted in several coal railways instead of the plate rail upon wood; and wherever they have been used they appear to have fulfilled every expectation formed of their utility, and have been universally approved.

The writer is indebted to Samuel B. Fisher, Esq., of Pottsville, Surveyor, for the following information respecting the cast iron rails employed in that portion of the anthracite region of Pennsylvania.

1. The lengths of rails most used are six feet; but some of twelve and fifteen feet are about to be cast, and any required length short of twenty feet can be made.

2. Some of the rails have been run at the blast furnaces direct from the ore, whilst others were cast by the cupola.

3. The rails are generally laid on cross ties, three feet apart, from centre to centre.

4. Some rails have been cast by Eckert & Guilford, at Pinegrove, with charcoal fuel, of the weight of eighty-four pounds per lineal yard, from a pattern furnished by B. Aycrigg, Esq., Civil Engineer, the section being that of the U, or bridge rail, *cast solid;* the rails now cast at Pottsville are similar to the T pattern.

5. If care is taken in moulding and removing the castings no warping occurs.

6. The rails used under ground for mines, weigh from twenty-seven to thirty-two pounds per yard, whilst others, for outside use, weigh from fifty-three to sixty pounds per yard running.

7. Cast iron rails are found quite smooth enough for use.

8. The cast iron rails cost from $ 40 to $ 45 per ton at the blast furnace, and $ 56 per ton when cast at the cupola from re-melted iron.

9. On the heavier rails, cars, weighing, with their loads, from four to four and a half tons, are drawn by horses at the rate of about four miles an hour.

10. Few, if any, instances have occurred of a rail breaking from regular use.

Mr. Fisher further states, that the rails cast at the foundries are preferred before those run at the blast furnaces.

On this branch of the subject, notwithstanding its importance in an economical point of view, there are no decisive experiments known to the writer, but this much we can declare, that it is by no means a settled point that castings made from re-melted iron are better than those which are run at the blast furnaces direct from the ore; at least, the idea of such superiority seems *to rest wholly upon opinion, and not upon experiment;* in the recent discussion which took place in New York, regarding the conduit pipes and other castings necessary for the supply of water to that city, it was stoutly maintained by the friends of the cupolas that castings from re-melted iron were the toughest and best, and this was as stoutly controverted by the advocates of castings run at the blast furnaces direct from the ore.

In the midst of the dispute, Frederick Graff, Esq., superintendent of the Water Works of Philadelphia, was appealed to, whose long experience in this matter entitles his opinion to the utmost respect, and he stated that the conduit pipes, and all the other castings, now, and for many years, used in the distribution of water through the city of Philadelphia, under a head as high as 100 feet, were made at the blast furnaces direct from the ore; Mr. Graff further declared, that after having, in 1821, repeatedly proved and examined pipes cast in

both ways, he had not been able, "with his experience, from that time to this, to determine why a pipe cast from the ore was not as good as one cast from re-melted iron, nor had he been able to determine why other castings cannot be made as perfect and durable from the ore as in any other manner."

On the other hand, the experiments detailed in Wood on Railways, third edition, page 127, show clearly enough, that a mixture of different kinds of cast iron forms a stronger, though also a heavier rail, than any one kind of iron cast separately; and this mixture can evidently be had only by re-melting iron through the agency of a cupola furnace.

But let this be as it may, there is no doubt that rails of sufficient strength can be most economically cast direct from the ore, and they would be cheaper than those produced at the foundries, even if it should be found necessary slightly to enlarge their dimensions.

The writer has been informed by Erskine Hazard, Esq., one of the managers, and Josiah White, Esq., the president, that the Lehigh Coal and Navigation Company having adopted a heavy T rail of malleable iron, for their railroad from Whitehaven, upon the Lehigh, to Wilkesbarre, upon the Susquehanna, a distance of twenty miles; contracted for it in England, at £10 10*s.* per ton; but one ship-load having been lost at sea, they resolved to supply its place with rails cast from anthracite iron, at the furnace now in operation upon Crane's principle, on the Lehigh Canal, about fifty-five miles below Whitehaven, the eastern terminus of the railroad; and with these they purpose laying about four miles of the road next to Wilkesbarre, on which horses are to be used.

The malleable iron T rail of the road referred to, weighs forty-eight pounds per lineal yard, and is near five inches deep, three quarters of an inch thick in the stem, and two inches wide on the head; the cast iron rail designed to supply its place upon four miles of the road, is of a similar section, but made six inches deep, a little larger every way, and weighs seventy-five pounds to the yard; it is cast in six feet lengths, direct from the ore, by anthracite worked with the hot blast.

The strength of this rail was tested at the furnace, with six feet bearing, and it required *more than* five tons weight to fracture it; consequently, at three feet bearing, its strength (with the same section being inversely as the distance between the supports,) is ten tons, but we have already shown, in a former part of this paper, that, according to Professor Barlow's experiments, and the relative properties of cast and malleable iron, an available strength of nine tons in a cast iron rail is ample to sustain the progress of trains carrying three tons on a wheel, and running at thirty miles an hour; consequently, if the

rail of the Lehigh and Susquehanna road is laid with three feet bearings, as is now contemplated, it will be equal to all the present exigencies of trade, and might be safely traveled by twelve ton locomotives at a very high speed; this rail covering *but two bearing spaces* between the joints, ought to have its supports spaced equally, which is, in fact, designed.

The writer has recently observed upon the Columbia railroad, a short distance laid with cast iron rails, apparently for trial; these are in section nearly parallelograms, about two inches thick by five inches deep; they are wedged in cross ties, about three feet apart, and appear to answer perfectly.

In a former part of this paper, we showed that a cast iron rail, of strength sufficient to resist, without permanent injury, a strain of nine tons, was equivalent in stiffness to a wrought iron rail of seven tons strength, and this ratio we took as the guide of comparison between rails of these materials; hence assuming that the weights of rails suitable for the same railway should be as these numbers, then if a wrought iron rail of seventy pounds per lineal yard is competent to carry any given trade, a cast iron one, proportioned for the same traffic, should weigh ninety pounds per yard, for 7 : 9 : : 70 : 90.

The cost of the *imported wrought iron rails* of the Lehigh and Susquehanna railroad, when delivered on the road, will be about $ 65 per ton, whilst those of *cast iron*, for the same road, will scarcely exceed $ 45; therefore, if the latter was strictly proportioned in strength to the former, the ratio of economy at the above rates would be,

70 tons at $ 65, - - - -	= $ 4,550
90 tons at $ 45, - - -	= $ 4,050
Difference, -	= $ 500

which, with these particular prices, would make the cast iron rails cheaper than those of English rolled iron, in the ratio of nine to eight; and if compared with American wrought iron rails, the relative economy would be still more conspicuous; the price of foreign railway iron delivered in America, fluctuates very much, but it is believed that it would very seldom be so low as to make the rolled rails cheaper than those of cast iron of equal strength, even if the former should continue to be admitted into our ports free of duty. We do not wish to be understood as asserting, in this paper, that cast iron rails are intrinsically superior to those of malleable iron; all that has been proposed is to show that the former material is equally sufficient and suitable for the formation of railways, whilst it is generally *more economical;* but there is one practical advantage which is inherent to cast iron, and ought not to be overlooked, it is, *that it expands and contracts*

less than wrought iron by alterations of temperature. Tredgold's essay on cast iron, informs us that whilst malleable iron expands $\frac{1}{143000}$ of its length by each degree of heat, cast iron elongates but $\frac{1}{162000}$ by an elevation of temperature to the same extent, consequently their ratio of comparative dilatation is nearly as seven to eight.

That cast iron is thus refractory under heat, is of some practical importance, for if the rails be cast in lengths of ten feet, the lineal elongation produced by an alteration of 100° in the temperature, would be only $\frac{1}{1620}$, or about $\frac{1}{14}$ of an inch, so that if rails of from six to ten feet lengths are used, and the laying is carried on at medium temperatures of the weather, they may then be placed almost, or quite in contact end to end, the unavoidable imperfections of the joints allowing sufficient play; and as the joints will therefore be so much closer than can be admitted with malleable iron rails, less objection will be made, even if their number should be greater.

James Herron, Esq., Civil Engineer, in a memoir descriptive of his patent Trellis railway, of continuous bearing,* which he has recently laid before the public, makes, at page 35, the following judicious remarks, touching the subject we have under discussion, and which we take the liberty of quoting:

"That cast iron rails can be furnished from our own mines at a much cheaper rate in the United States, than foreign rolled iron rails, seems probable from the improved modes of smelting iron with anthracite coal. That they will fully answer the purpose, when constructed and laid as I have described, there are but few engineers of practical experience in mechanics, and who are familiar with the extensive use made of cast iron edge rails throughout England and Wales, on their mineral railways, will deny. Should there be some, however, who are disposed to advance adverse views, it matters not from what motives, let me ask them why is it that the chilled cast iron wheels of our railroad cars should have so completely superseded the imported wrought-tired wheels, if it be not their *greater durability and cheapness* that recommended them?

"Within the last two years, some millions of dollars have been sent out of the country for the purchase of railway iron, which has been, for the most part, admitted duty free, and if we may form an opinion from the rapid deterioration by crushing, exfoliation, and splitting of the heavy rolled iron rails but recently laid *on some of our roads*,

* A very ingenious railway of continuous bearing, has been devised by B. H. Latrobe, Esq., Civil Engineer, (see the March No. of this Journal, 1841,) consisting of a Z rail attached laterally to a continuous string piece; this peculiar arrangement is strikingly deserving of trial upon a working scale, and *on a bed of concrete.*

many millions more must continue to follow them, to furnish a supply for the renewals and repairs, so that it will form an insatiable drain on the currency of the country.

"A material that enters so largely into, and forms so costly a part of, our great public works, should not, therefore, be imported from a foreign country, if we can by any possible device render our native materials available. That the large sums of money which would thus be retained in the country would greatly benefit the mining, manufacturing, and farming interests, and, in fact, all others, even the works themselves, by an increase of business, must be evident to all."

Reflecting, then, upon the following facts, that for a long series of years cast iron rails were successfully used in England for public railways, that they are now used a great deal in the mineral districts, that they were originally superseded, in consequence, chiefly, of the superior economy of malleable iron rails, that so far as they have been used in this country they have fully answered every expectation, that the peculiar character of the strains upon a railway is such as cast iron is well calculated to withstand, that they can be well and cheaply made in this country, instead of sending our money abroad for foreign iron, that the transportation of iron rails from the sea-board to many of the interior railways, is very expensive, and finally, that they are as cheap, or cheaper, than wrought iron rails of equal strength*—can there be any reason why cast iron rails should not be universally adopted in the United States? On the contrary, are we not urged to their exclusive use by every consideration of economy, as well as of patriotism in supporting home, instead of foreign manufactures? And do not the arguments in favour of *cast iron rails*, appeal with peculiar force to all those states, which, like Pennsylvania, possess within their bosoms inexhaustible supplies, both of the ores of iron and the means of fusing them into metal?

Philadelphia, September 1st, 1841.

Remarks on the Bear Valley Coal District, in Dauphin county, Pennsylvania. By Walter R. Johnson, *A. M., Civil and Mining Engineer, Professor of Chemistry and Natural Philosophy, in the Medical Department of Pennsylvania College, Philadelphia. Late Professor of Mechanics and Natural Philosophy, in the Franklin Institute.*

This coal district embraces a very large amount of valuable coal land, and is one of the most accessible and most easily wrought, of all our Pennsylvania coal deposites.

* The Congress of the United States, at their late session, have passed a law providing that from and after the 3rd of March, 1843, all foreign railroad iron imported into this country,

It lies between Lykens' Valley on the north, and Williams' Valley on the south; these two valleys being bounded, the former, on the north by Mohantango Mountain, and the latter, on the south, by Berry's Mountain.

These are termed red shale valleys, and are rich, productive, and extensively cultivated, yielding abundant supplies of agricultural produce suitable for a large mining district.

The coal formation proper is included in an elongated basin, or trough, called Bear Valley, situated between two elevated ridges, viz: Thick Ridge, on the north, dividing it from Lykens' Valley, and Big Lick Ridge, on the south, which separates it from Williams' Valley.

The approach to this valley is through a deep cut, or gap, in the Big Lick Ridge, called Bear Gap, formed by a creek which comes out of the valley and joins the Wiconisco, by which its waters are conveyed to the Susquehanna river at Millersburg.

This gap extending quite through the southern brim of the trough, and dividing the various beds of which the coal measures are composed, has left the edges, or rather *ends* of the coal seams so exposed, as to be entered by horizontal drifts, or gangways, involving no necessity for artificial draining. The coal seams both east and west of the gap, dip northwardly in an angle of about forty-five degrees, and hence when the gangways have been driven to the proper extent, the workings commence in an ascending direction, and the coal is delivered to cars in the gangways over shutes formed on the floors of the beds themselves. On some of the beds the breadth of working, or breast of coal, will not be less than 600 or 800 feet. In others it will probably exceed 1000 feet. This facility of delivering the coal obviates the necessity of handling it after being detached from the solid bed. The mines which I examined were perfectly dry, and more comfortable, therefore, than almost any others which I have visited in the anthracite coal fields.

But besides the facility of mining the coal on the southern side of the trough by means of the exposure of the ends of beds at the gap, there is the additional advantage of approaching the northern or south-dipping beds by means of a tunnel to be carried horizontally across the beds northwards, and through all the interposed strata of slates, sandstones, iron ores, fire clays, &c., and as each successive bed is reached, working right and left by drifts in a manner perfectly analogous to that which is now pursued at the gap.

The openings on these south-dipping beds, on the property of the Lykens' Valley Coal Company, at different heights on the slope of the ridge, have disclosed the fact that in numerous beds good coal is found even at a very few feet from the surface, with roofs and floors

shall be subject to "a duty of twenty per cent. ad valorem," and that no iron shall, hereafter, be allowed to enter duty free, except what may be required for railroads, or inclined planes, *now under construction.* This act would seem to settle the question of economy decidedly in favour of the use of cast iron rails, on all future railroads constructed by the American people.

of adequate consistence to allow of mining to within a few yards of the outcrop.

If all the beds of the formation, known to be eighty feet in aggregate thickness, lay in a horizontal position, a single acre of land in which they were so situated would contain 129,066 cubic yards, or the same number of tons of coal; and if the same thickness of coal in a single bed, or succession of beds, were inclined at an angle of forty-five degrees, the quantity of coal in an acre would be increased in the proportion of 142 to 100, or it would then be 183,273 tons. All the beds of an inclined formation may be worked on a single acre of land, supposed to extend in a very narrow strip quite across the breadth of the trough, and the whole number of acres may therefore be considered as possessing like advantages over the same number of acres, of which the strata should be supposed horizontal. Now 370 acres of the above company's lands lie in a broad belt stretching directly across the coal measures, and embrace as well those parts of the beds which lie below water level, as those which in the two mountain ridges rise up several hundred feet above that level. In these 370 acres there would be found, by the preceding computation, 183273 × 370 = 56,268,010 tons of coal. Admitting that from denudation and other causes, only one-tenth as much coal shall ever be obtained, the yield of this small portion of the lands will be 5,626,801 tons, or such an amount that if 50,000 tons per annum were taken out, a century would be far from exhausting this limited part of the company's domain.

The present workings have hardly passed the threshold of the formation—and are in the thinner and less valuable beds, as all observation and experience tend to demonstrate. Even on the "Gap tract," so called, many of the more important beds of the formation remain yet to be explored.

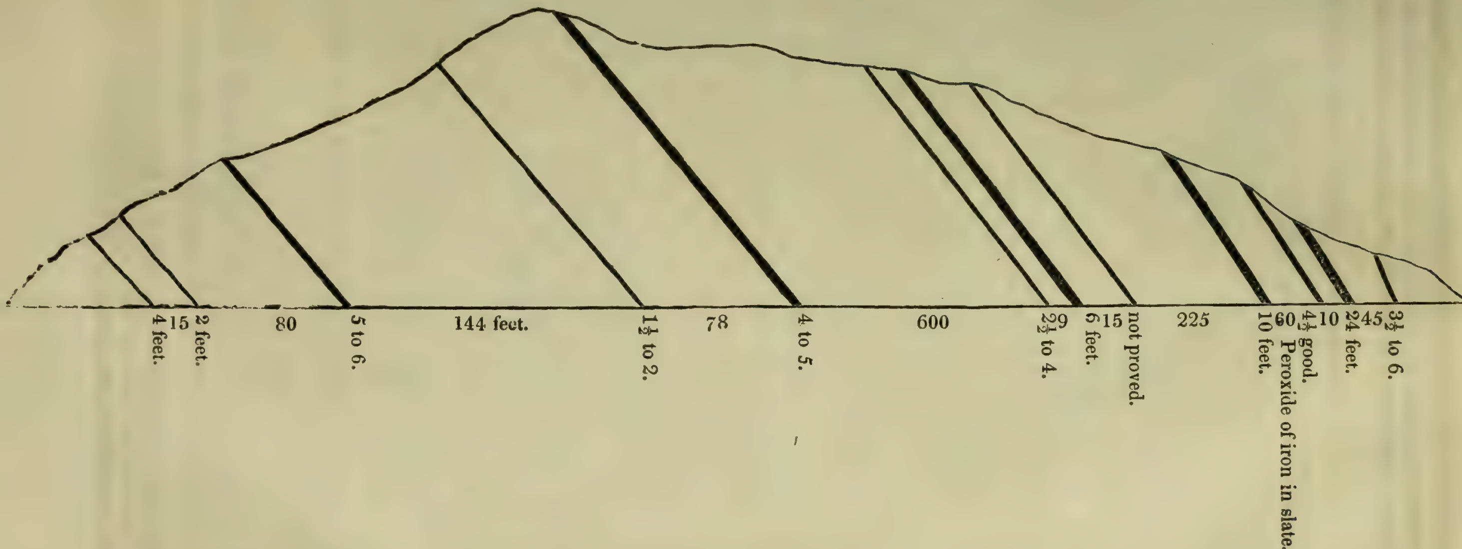
The following sketch exhibits the inclination, thickness, and distance apart of the beds in Thick Ridge, as observed and carefully measured at Raush Gap, and confirmed by numerous openings opposite to Bear Gap. For this sketch I am indebted to Mr. P. W. Schaeffer, who prepared it from actual measurements. The dip is south eight or ten degrees east, about forty degrees.

From this sketch it appears that the total thickness of coal in the formation is not less than eighty feet on the north side of the trough, (and the same will doubtless apply to the south ridge,) and that more than two thirds of this thickness is found in seven beds lying in the inner, or *upper*, portion of the formation, and within a space of 130 yards measured horizontally across the strata. The openings at Bear Gap demonstrate the same general feature. Hence it is confidently believed that in a distance of two hundred yards, at most, all these beds will be reached by the tunnel above proposed, if commenced in the most favourable situation.

The tunnel might be twelve feet wide and seven high, and its execution might be progressive as new beds were required to be opened. The cost of excavation could not, I judge, in the materials here found, exceed ten dollars per lineal foot, for the first 200 yards.

Section in Thick Mountain, East side of Rausch Gap.

P. W. Shaeffer.



In the beds to be reached by this tunnel, coal could be mined for fifty cents per ton, agreeably to the estimate of Mr. Schaeffer, who has been long conversant with the operations in this coal field.

Character of Lykens' Valley Coal.

This coal is of the variety generally known in commerce as free burning red ash coal. It enjoys already a high reputation for giving, when used for domestic purposes, a steady but lively heat, and yielding little earthy residuum. It is also highly esteemed by smiths and founders; and not less so by those who have applied it to the production of steam, the burning of lime, and the smelting of iron.

The exterior characters of the coal of different beds are somewhat various; and it is not a little remarkable that the kind most sought after by blacksmiths, is that which, at first sight, might seem the most unpromising, being often covered almost entirely with a coat of yellowish or red oxide of iron, from which it has received the name of the "rusty vein." In other beds the coal is of the clearest jet black, and presents the varieties of tint, dull and bright, due to a greater or less intermixture of mineral charcoal with the pure anthracite.

The following analyses of this coal, with the subsequent comparison between it and the Welsh anthracite used by Mr. Crane, may be interesting in view of its applicability to iron manufactures.

The anthracite of Bear Valley is marked with numerous impressions of the vegetable substances from which the coal has been derived. These are not confined to the slates, but penetrate the body of the anthracite itself. The fossils are precisely similar in kind to those found in this and other countries, among the beds of bituminous coal, and correspond perfectly with descriptions already extant; and the minutest characteristic line traced on a bituminous coal slate in Great Britain, France, Germany, or South America, has its exact counterpart in the anthracite fields of Pennsylvania. Indeed there can no longer exist a question about the fossils of anthracite and bituminous coals belonging to the same geological period, since we know, that in one and the same coal trough we have perfect anthracite at one end, and perfect bituminous coal at the other, with a regular gradation of qualities between them.*

Among the many varieties of anthracite found in Pennsylvania, none, according to my observation, bears a stronger analogy to that of Yniscedwyn in Wales, used at Crane's iron works, than the coal of Lykens' Valley.

The first step in tracing this analogy is to mark the relation by external characters.

These, in the Welsh coal, are,

1. A structure often lamellated, and tending to separate at the surfaces of deposition, owing to the quantity of carbonaceous clod which constitutes the dull seams between the bright plies of coal.

* The fossils most frequently observed at Bear Valley are various species of Filicites Stigmariæ, Lepidodendra, Calamites, &c. A specimen of Stigmaria ficoides four inches broad, was found imbedded in pure anthracite.

Tabular view of the Analyses of nine samples of Anthracite from the mines of the Lykens' Valley Coal Company.

No. of the sample.	Specific gravity.	Water expelled at 320°.	Volatile matter lost at redness.	Fixed carbon.	Earthy residue.	Exterior and other characters of coal.	Character of ashes.
1	1.391	1.460	6.140	87.950	4.450	Deep black—fracture irregular, shining—or dull from intermixture of charcoal—of which the structure is distinctly seen—and which is soft, sectile, and easily combustible—gives out gas, but does not change form on being ignited.	Colour deep brown—inclining to reddish brown—light—little coherent, moderately gritty.
2	1.404	1.390	4.56	89.300	4.750	Brownish black—iridescent or steel blue—surface shining and striated—woody structure of the mineral charcoal seen as above—gas burns brightly.	Light fawn colour, moderately gritty—light—slightly coherent.
3	1.416	0.70	9.30	85.700	4.300	Lustre silky on a carbonaceous ground — mixture of mineral charcoal in certain parts, with a coke-like mass.	Brownish buff—slightly coherent.
4	1.374	1.10	3.50	88.700	6.700	Very similar to the preceding.	Brownish — dirty red, with slight tinge of purple — very slightly coherent — incineration probably not quite complete.
5	1.376	0.88	7.47	87.750	3.900	Colour deep black—fracture uneven with appearances of coke or charcoal.	Yellowish red — inclining to brown—dense—coherent.
6	1.395	0.90	7.40	88.650	3.050	This sample is less marked with carbonaceous deposites than the preceding—a purplish red tint marks some of the partings, or cross cleats.	Colour deep fawn, gritty—heavy, coherent.
7	1.382	0.090	7.75	87.200	4.150	Colour deep black—surface shining, striated, silky, and occasionally of a dull charcoal lustre—fracture uneven, original grain apparently obliterated by pressure.	Bright fawn—with slight tinge of rose colour, gritty, coherent.
8	1.398	1.314	10.54	83.996	4.150	Appears to resemble certain varieties of bituminous coal in structure, fracture and lustre, with slight specks of pyrites.	Bright buff colour, tolerably coherent—slightly gritty.
9	1.378	1.360	5.94	87.000	5.700	Dull black—surface shining at the fractures which cross the grain of the coal—horizontal seams conspicuous, fine carbonaceous dust seen in the interstices.	Incineration not quite perfect, minute particles of coal perceptible—colour deep fawn.
m'an	1.390	1.111	6.955	87.360	4.572		

2. The abundance and magnitude of reeds and stems constituting the charcoal deposites, traversing the anthracite.

3. The shining and polished surfaces occasionally presenting themselves to view at some of the natural partings.

4. The purplish tints of metallic oxide often observable on the surfaces of fracture.

5. The general colour is deep black, and either dull, or shining, according as the ply which is examined belongs to the anthracite itself or to the carbonaceous clod partings of the seams.

By observing attentively the external characters described in the seventh column of the preceding table, it will be seen that all the foregoing distinctive marks belong also to the anthracite of the Bear Valley coal field.

The next circumstance worthy of attention in tracing the relation of coals, is their specific gravities. In the Welsh anthracite this is from 1.336 to 1.372, not much greater than that of many bituminous coals. The nine samples of the table above given afford a mean specific gravity of 1.390; the highest being 1.416, and the lowest 1.374.

The quantity of *volatile matter* next deserves notice. Of this, the Welsh anthracite contains by the mean of *two* trials made by myself, - - - - - - 9.18 per cent.
of *two* by Mr. Mushet, 7.23 "
of *one* by Mr. Frazer, - 7.60 "

The mean of these *five* is - - - 8.072

The water and *other volatile matter* in my analyses of Lykens' Valley coal are separately determined; the mean of water is 1.111, and of other gases, 6.955; the sum of which is 8.066.

The mean quantity of earthy matter in the Welsh anthracite by three of Mr. Mushet's trials is - - 3.578
by one of Mr. Frazer's - - 5.080

and the average of these two is - 4.329

In the Lykens' Valley anthracite, the table shows a mean of 4.572.

The quantity of carbon in the coal of Yniscedwyn as deduced from the preceding data is 87.599, while the table shows 87.360 in that of Lykens' Valley.

Bringing the preceding statements into a single view, the analogy will be perceived at a glance.

	Sp. Gr.	Vol. Mat.	Carbon.	Ashes.
Yniscedwyn coal,	1.354	8.072	87.599	4.329
Lykens' Valley do.	1.390	8.066	87.360	4.572

If any thing more were wanting to make out the absolute identity of character in these coals, so remote from each other in locality, it would be supplied by the perfect similarity of effects observed to result from their distillation, yielding at first a gas burning with a pale blue flame, and afterwards, as the temperature rises, one of strong illuminating power, accompanied by a minute portion of bituminous, condensible matter. The illuminating gas seems to commence sud-

denly its development from the Welsh coal, and perhaps also from that of Lykens' Valley, but in the latter this circumstance was not particularly noted.

Rich and valuable as are the beds of anthracite in Bear Valley, it will be seen from what follows that these are not the only minerals worthy of consideration, embraced within the district. Like all other known coal formations, it is interspersed with seams of argillaceous carbonate of iron, but as no researches have yet been expressly directed to this object, but little more than the outcrop has hitherto been explored.

Iron Ores.

The following analyses of the iron ores found in contiguity with the coal beds of Bear Gap, were made in the dry way, and may, consequently, be regarded as very nearly representing the results which would be obtained in the process of actual manufacture, except that as the ores were from near the outcrop of the bed they are rather richer in iron than they would have been, if not exposed to the influences of air and moisture.

No. 1. *Species.*—Argillaceous carbonate, passing into hydrated peroxide of iron.

Description.—Form spheroidal; texture, coarse; colour, from grayish blue to reddish brown.

Specific gravity, at 62° Fahr.	3.40.	
Water expelled at 350° - -	2.82	per cent.
Loss by calcination, - -	20.87	"
Pig metal obtained, - - -	42.37	"
Earthy matter, - - -	21.84	"
Oxygen, - - - -	12.10	"
	100.00	

The pig metal obtained in this assay was moderately hard, amorphous, or granular in structure; of a mottled grey colour. The cinder was ash-coloured and opake.

No. 2. *Species.*—Hydrated peroxide of iron—argillaceous.

Description.—Colour, reddish brown; fracture irregular—sectile—soils strongly.

Specific gravity, at 64°	3.347.	
Water expelled at 320° - - -	0.89	per cent.
Loss by calcination, chiefly water, -	10.51	"
Yield in pig metal, - - - -	51.35	"
Oxygen, - - - -	22.00	"
Earthy matter, - - - -	15.25	"
	100.00	

Pig metal moderately hard; structure, fine granular; colour, lively grey.

Cinder—a purplish, semi-transparent glass.

No. 3. *Species.*—Nearly the same as the preceding, and probably derived from the same bed.

Specific gravity, at 69°	3.286.	
Water lost at 320° - - -		1.00 per cent.
Loss by calcination, - - -		10.13 "
Pig iron, - - - - -		51.60 "
Oxygen and earthy impurities, -		37.27 "
		100.00

Pig metal lively grey, moderately hard, and rather brittle, compact; fracture smooth.

Cinder—a purplish, smoky glass.

No. 4. *Species.*—Argillaceous carbonate of iron, nearly hydrated or transformed into hydrated peroxide of iron.

Description.—Colour, bluish grey; structure, coarse, hard; fracture, uneven, splintery.

Specific gravity, at 61°	3.463.	
Water lost at 320° - - -		14.95
Loss by calcination, - - -		9.92
Pig iron, - - - -		51.80
Earthy matter and oxygen, - -		25.33
		100.00

The pig metal is compact, but soft; dark mottled; lighter portions ranged in minute pentagonal figures. Cinder, a black glass.

No. 5.—Characters similar to the preceding.

A portion of the exterior shell is sectile; interior, hard.

Specific gravity, at 61°	3.480.	
Water lost at 320° - - -		1.69
Loss by calcination, - - -		10.83
Pig metal obtained, - - -		54.15
Earthy matter, - - - -		13.66
Oxygen, - - - -		19.63
		100.00

Pig metal soft, moderately tough; dark mottled; fracture rough, without signs of crystalization. Cinder, a dark coloured opake glass.

Tabular view of the Analyses of Iron Ores of Bear Valley.

Specimen	1	2	3	4	5
Variety of ore.	Argil carb. and hyd. perox.	Hyd. oxid.	Hyd. oxid.	Argil. carb. and hyd. oxid.	Argil. carb.
Specific gravity,	3.40	3.347	3.286	3.48	3.463
	per cent.	per cent.	per cent.	per cent.	per cent.
Loss by calcining,	23.09	11.40	11.13	12.52	14.88
Pig iron,	42.37	51.35	51.60	53.05	51.80
Earthy matter, &c.	34.54	37.55	37.27	34.43	33.32

The specimens above analyzed are all from near the outcrop of a bed, as indicated by the hydrated shell, or crust, on the exterior, and

are therefore richer in iron than the average of the same bed will be, when pursued under a sufficient covering, to yield the blue argillaceous carbonate in its unaltered state. It will then probably range somewhere between thirty-three and forty-two per cent. of metallic iron; give a loss of more than thirty per cent. by calcination, and contain, perhaps, twenty-five per cent. of earthy matter.

The distance from the point where I have proposed that a tunnel shall be commenced, to the Susquehanna river, is sixteen miles, traversed by the Lykens' Valley Rail Road. The superstructure of this road requires to be renewed with T rails, fit to bear transportation by locomotives, and the grading on one section to be altered so as to render the whole line either level or descending in the direction of the freight. This alteration will likewise improve the *plan* of the road, removing, or diminishing, several curves, and with these changes, it will, I conceive, be made one of the best railroads for descending tonnage in the coal regions of Pennsylvania. It terminates on the river at the mouth of Wiconisco creek, and at the commencement of the Wiconisco canal. This canal, 12½ miles long, connects with the Susquehanna canal at Clarke's ferry, is now nearly completed, requiring only one or two aqueducts and two or three locks to be made, with unimportant excavations to be finished, to place it in a condition to receive the water. Of an original estimate of $ 416,000 for making this canal, $ 364,500 have already been expended, leaving only a balance of $ 51,500 required to complete the work. For this comparatively trifling sum, it is not to be supposed that the state will forego the advantage of receiving the great amount of tolls which this mineral region can bring, not only to the Wiconisco, but also to the whole line of state canal from Millersburg to Columbia, a distance of fifty-three miles.

The coal will reach tide water at Havre de Grace, 98½ miles from Millersburg, where it will have cost, agreeably to an estimate by Mr. Schaeffer, (which seems to me ample for every item of the expense, at least in the aggregate,) the sum of $ 3.12½ per ton. The boats used on this line of navigation will carry sixty-five tons, and being covered over with suitable hatches, may be towed to Baltimore, in which case, the coal delivered on the wharves need not cost over $ 3.50 per ton.

In conclusion, I would remark, that I know of no other anthracite coal district among the many hitherto brought into active operation, which combines all the advantages possessed by that of Lykens' Valley. Its abundant supplies of coal and iron ore, its facilities for mining, the excellence and high repute of its coal, its fortunate connexion with a well located rail road, and at the end of that, with a capacious canal terminating at tide water, and having the Susquehanna river for its supply, with all the markets both of the south and east accessible during every month in the year, from the city of Baltimore, where the main depots of this coal will naturally be made, are circumstances which cannot be overlooked by any one who understands the value of a coal formation, or the innumerable purposes to which its treasures are applied.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1840.
With Remarks and Exemplifications by the Editor.

1. For a method of *Channeling and Scarfing the Soles of Pumps, Shoes, &c.;* Lewis Baker, Fort Plain, Montgomery county, New York, September 2.

The apparatus used consists of an iron *form* of the shape of that part of the sole to be channeled and scarfed, which is to be tacked on to the said sole, and of two cutting instruments, one attached to each end of a handle. One of these has three knives projecting from the end of a block of iron, or steel—the outermost of which is sufficiently long to cut through the sole, and the other two of half that length, and as far apart as the width of the tongue to be formed. The other instrument is formed with a gauge, in place of the long outside cutter of the first instrument, and of two cutters that incline towards each other, their points being as far apart as the width of the tongue, so that they may cut out two parallel triangular strips of leather from each side of the tongue. An instrument used for making a channel on the inner side of the tongue, and scarfing the outer edge of the sole is also described, and is similar to the one last named, excepting that the cutter next the guard instead of inclining towards the other cutter, inclines in the same direction with it, and towards the guard.

The form serves as a guide in using the instrument. Claim.—"What I claim as my invention, and desire to secure by letters patent, consists in the combination of the cutting instruments with the form as before described."

2. For an apparatus for *Boiling and Washing Rags,* used in the manufacture of paper; George Spafford, Windham, Windham county, Connecticut, September 2.

The patentee says—"In my improved boiler and washer, the rags are to be subjected alternately to the influence of high pressure steam and an alkaline liquid; said boiler being so constructed as to be capable of being made to revolve upon its axes, which are formed hollow, for the purpose of introducing steam from a separate, or ordinary engine boiler; and also of introducing water, or an alkaline solution, when desired, for the purpose of washing the rags which have been boiled.

"Having thus fully described the nature of the apparatus used by me, &c., what I claim is the construction and use of a cylindrical, revolving boiler, and washer, the interior of which is divided into four, or any other convenient number of compartments, by grated partitions, within which the rags are to be subjected to the action of high steam, and of an alkaline solution, in the manner, and for the purpose above set forth."

Each of the compartments, into which the cylinder is divided, is provided with a hole, and cover, similar to that of the main hole of a steam boiler, for the purpose of putting in and removing the rags, &c.

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3. For an improvement in the machine for *Cutting Staves;* Isaac Hosmer, and William P. L. Badger, Concord, Middlesex county, Massachusetts, September 2.

This machine is designed as an improvement on that kind of stave-cutting machines which cut them from a block, or bolt, by means of a curved knife attached to radial arms, and the improvement consists in shifting the position of the axis of vibration, by having the axle to slide in slots in the arms, so as to make staves for barrels of greater or less diameter. The standards in which the axle has its bearings are also made to slide, that they may correspond to the change in the length of the arms without changing the position of the knife.

Claim.—"We claim the method of shifting the axis of vibration without changing the position of the knife, by means of the movable standards, in combination with the shaft, or arbor, and the slots in the radial arms, as described."

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4. For an improvement in the machine for *Making Stove Pipes, Mouldings, &c.;* John Farrar, Cuyahoga Falls, Summit county, Ohio, September 2.

This patent is taken for a modification of the machine well known to sheet iron workers, in which the stove pipe is formed by rolling the sheet on a cylinder which works against a roller, the cylinder being provided with a groove along it, which receives one edge of the sheet of iron. The so called improvement consists simply in substituting for the roller, against which the cylinder works, a concave bed, which surrounds one half the circumference of the cylinder, and the claim is limited to the "employment of a cylinder with a groove, in combination with a concave bed."

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5. For a machine for *Making Rivets;* Alpheus Fobes, Assignee of Charles Lyon, and Fitch W. Taylor, Assignee of Alpheus Fobes, Assignee of Smith Gardner, and Assignee of Charles Lyon, of New York City, September 2.

The claim is confined to the method of feeding the rod, and to the arrangement of the parts constituting the die plates; and as the claim refers throughout to the drawings, and could not be understood without them, we will merely furnish a general idea of the principal characteristics of the machine.

The tongs which hold, and carry the rod forward, are put in motion at each operation of the machine by a connecting rod, which receives motion from a pin, on the crank which actuates the leader. When the tongs are drawn forward to feed, a projection from the connecting rod first comes into contact with the levers, or handles, of the tongs, and causes them to gripe the rod, the whole then moves

together to the distance required to make the rivet; and on the return of the connecting rod, which is effected by a spiral spring wound around it, the levers of the tongs are first liberated, and then drawn back to be ready for a second operation. The die plate is provided with two dies, one permanent, and the other movable, and the rod passes through a hole in a plate, on the face of which the die plate slides. In the operation of the machine, the sliding die is first put in motion, which gripes that end of the rod which is to be made into a rivet, the whole die plate then slides past the hole in the plate, on the face of which it works, thus cutting off the blank and preparing it to receive the blow of the heading die.

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6. For a machine for *Making Hook, or Brad-headed Spikes;* Henry Burden, Troy, New York, September 2.

The patentee says—"In my improved machine, the feeding in of the rod, the cutting it off, and the pointing of the spike, are effected in the way previously used by me for performing the same offices in my ordinary spike machines, or adopted by others; and my improvement for forming the spikes with hook, or brad, heads, may be applied to spike machines of various constructions.

"My improvement consists principally in the employment of what I denominate a bending lever, or some analogous device, by means of which a portion of the rod which is to constitute the head is bent down so as to form an angle with the shank, and in then forcing up a heading die, properly formed, so as to upset the bent portion, and to cause it to assume the desired shape."

The claim is limited to the bending that portion of the rod which is to be formed into a hook head, by means of the bending lever, and also in forming the heading die and the parts of the griping dies, within which the bent part is to be upset, so as to give the proper form to the hook, or brad-head.

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7. For an improvement in the machine for *Cutting Veneers;* John Dresser, Stockbridge, Berkshire county, Massachusetts, September 2.

This machine, like some others, is to cut the veneer from a block, by means of a knife, the edge of which is forced against the block; the novelty consists mainly in so modifying it as to make it applicable to the cutting of veneers from a round log. Such a log is to be fixed to the mandrel of a lathe, and held by a centre screw; the knife is attached to a frame, or carriage, which slides on the bench at right angles to the axis of the log. As the log is put in motion the knife is forced up to it, and cuts therefrom a veneer, the thickness of which can be regulated by the change in the relative motions of the log and knife. The claim is limited to the manner of "cutting veneers with a knife from cylindrical blocks of timber, revolving in a common turning lathe, or other similar machine."

8. For an improvement in *Railroad Switches;* Nathaniel Eaton, Worcester, Massachusetts, September 3.
(See specification.)

9. For an improvement in the *Paper Engine;* William Dickinson, Worcester, Massachusetts, September 3.

Heretofore, the cylinder of the paper engine has been hung with one gudgeon in a permanent box, and the other in a box attached to a lever, called by paper makers a "lightener," and serving to elevate, or depress, the cylinder; but as this acted on one end only of the cylinder, an exact parallelism could not be preserved between the surface of the cylinder and the knife below it. To remedy this defect is the object of the improvement under consideration, and this consists in adding another lightener to the other side of the cylinder, and connecting the two together, so that in elevating, or depressing, the cylinder its surface shall always be parallel with the cutters below. To this improvement, or device, the claim is confined, and it would be difficult to confine a claim within narrower limits.

10. For *Flower Pots, or Vases;* Joseph Adams, Boston, Massachusetts, September 3.

The vases, or flower pots, described, are to be made of wood, earthen, or stone ware, or of any other suitable material, if made of any material which will allow water to percolate through its pores; the vase is to be lined with metal. A metal vessel is made to fit within the vase, the lower part of which is of such diameter as to leave a chamber for water between it and the inside of the vase. The lower part of the inner vessel is perforated with a few holes, through which the water is supplied to the plant. The claim is confined to the inner vessel, constructed as described, in combination with a flower pot, or vase. If we have not seen, we have certainly dreamt of ornamental vases, or flower pots, so nearly like the foregoing that they might be mistaken for twins.

11. For *Constructing, and Supplying Water to, Steam Boilers;* Cadwallader Evans, Pittsburgh, Pennsylvania, September 3.

The improvements described in this specification are applicable to that kind of steam boilers generally used on the large boats of the western waters, in which a number of cylindrical boilers are arranged side by side. The first improvement is in placing the pipes of communication between the respective boilers in the same tier above the tops of the flues within, so that when the boat careens, the water cannot flow from one to the other, below the tops of the contained flues, thus avoiding one of the causes of those accidents which are believed to arise from the over-heating of the flues when not covered by water. The second improvement consists in combining with the foregoing the manner of arranging the supply tubes so as to force the water into the outside boilers only, and at the same elevation with the tubes

of communication; thus insuring a sufficient and equal supply to all the boilers; the end boilers being always supplied up to the level of the communication pipes, no matter how much the vessel may careen.

The third improvement consists in placing a balance valve in the supply pipe, so constructed as that when the boat careens the weight of the valve will cause it to close the pipe that leads to the lowest valve, and thus force the whole supply of water to pass through the most elevated boiler.

The claim is confined to these three improvements.

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12. For a machine for *Separating Garlic from Grain;* William C. Grimes, York, York county, Pennsylvania, September 3.

The patentee says—"I proceed upon the fact, or principle, that the wheat, or grain, will completely resist any force which would be necessary to drive the garlic through a groove, or crevice." "But whatever may be the form or modification of the machine, I prefer, and use no other than projectile force."

A hollow, radial, chambered wheel revolves within a case surrounded by rings, which form conical openings, or grooves, all around, which either revolve in connection with the wheel, or remain fixed. The grain is fed into the hollow shaft of the wheel through an appropriate hopper, and is discharged by centrifugal force through the conical grooves formed by the rings.

Claim.—"What I claim as new, as my invention, and desire to secure by letters patent, is the mode of separating garlic, and other foreign matter, from wheat and other small grain, by means of the combined action of a hollow radial chambered wheel, and a series of rings, revolving in connection with, or remaining fixed around it, as herein set forth; the rings forming a narrow wedge-shaped groove, into which the grain, garlic, &c., is thrown by the radial wheel, when the separation ensues, as described."

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13. For an instrument for *Ascertaining the quality of Lamp Oil;* John W. Harris, Dorchester, Norfolk county, Massachusetts, September 3.

The improvement claimed consists in the oleometer scale, and in the manner of using it in conjunction with a thermometer. The scale consists of three parts, two of which are united together at their ends, and at such distance apart as to admit the third to slide between them. These are so divided as to indicate the specific gravity of different specimens of oil, and at certain degrees of temperature, which are indicated by the thermometer.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of the oleometer scale, also the mode of ascertaining the quality of spermaceti oil at any particular temperature, by means of the aforesaid scale, in combination with the oleometer and thermometer, as herein set forth. I disclaim as my invention the oleometer itself."

14. For a *Cement for Covering Buildings, Floors, Steps, Side-walks, &c. &c.;* Jacob Bump, Kirtland, Ohio, September 3.

The following are the ingredients which are to compose this cement, viz. "To one bushel of clean sand add half a bushel quick lime, one eighth of water lime, one eighth of pulverized hard stone, granite or clean gravel, half a gallon of hot tar, one pound of copperas, one pound of alum, one eighth of a bushel of furnace, or smith's cinders. Pulverized glass will answer." "The above ingredients to be well mixed together, and after one day, or more," we are told, "it will be fit for use, to be kept tempered, and to be spread like mortar."

The claim is limited to the composition of cements formed of the afore named ingredients. We can scarcely imagine a mixture more heterogeneous.

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15. For an improvement in the method of *Opening and Closing Window Blinds;* George Butterfield, Hopkinton, Merrimac county, New Hampshire, September 4.

This patent is for a method of opening and closing those window blinds which slide horizontally. A bar extends across the window, about midway of its height, which bar is embraced by plates attached to the inner edge of each half blind; each section of the blind has a rack affixed to it, which racks are actuated by the leaves of a pinion fitted in the window frame, and provided with a winch, by which the whole is operated.

The claim is to the "mode of opening and closing blinds by the combination of the bar, racks, pinion, and crank, as described."

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16. For an improvement in the *Stencil Plate* for facilitating the painting of signs, marking boxes, bales, goods, &c.; Edwin Allen, Windham, Connecticut, September 4.

Two grooved strips are joined together at their ends so as to receive separate plates of metal, in each of which is cut a distinct letter, which may be set up and changed at pleasure. The frame, with the plates, or letters, is placed upon the article to be painted, or lettered, and the brush passed over the letters, or plates. The claim is to the "combination of the perforated plates and frame, as before described, for marking boxes, bales, &c. &c."

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17. For an apparatus for *Transmitting Heat by the Circulation of Hot Water;* Angier M. Perkins, a citizen of the United States, now residing in London, England, September 4th, 1840; antidated August, 1838, date of English patent.

The patentee says—"My invention consists in transmitting, or transfering, the heat from the fire to the aforesaid water, or other fluids, by means of the circulation of water in tubes closed in all parts, and as letters patent under the seal of the United States, have heretofore been granted to me for warming the air in buildings, and also for

heating water, and other fluids, by means of the circulation of water in tubes closed in all parts, and moreover, as the circulating hot water tubes which I now propose to employ, are, in many respects, similar to those for which the aforesaid letters patent were granted. Now, I declare that my present improvements are intended to make such addition to the aforesaid circulating hot water tubes, and such alteration thereof, as shall render them more fully applicable to the several purposes before mentioned." "I claim as new the following parts of the apparatus, viz. Firstly—The combining of a force pump with the circulating tubes, arranged and combined as set forth, closed in all parts, excepting in that for the admission of water from said pump. Secondly—The supplying the tubes with water by means of a valve opening inwards, within a cistern constructed and operating substantially, as described; the water being thereby allowed to enter said tubes by its own gravity, or by atmospheric pressure, whenever a deficiency arises from either of the causes within enumerated. Thirdly—The combining with said apparatus what I have denominated the expansion, or safety valve, for allowing a portion of water to flow out of the tubes when expanded by heat. Fourthly—The employment of a portion of the circulating tubes of my system of closing tubes, to constitute fire bars, as set forth; not intending to claim as of my invention the using of hollow fire bars communicating with a steam boiler, this having been before done. Fifthly—The manner of using the expansion and contraction of one of the hot water tubes, in combination with my system of circulating tubes, as a heat governor, or regulator, whereby the fire is kept at any required degree of intensity, and the tubes at any required temperature."

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18. For improvements in the machine for *Moulding and Pressing Bricks;* Stacy Costill, Philadelphia, Pennsylvania, September 4.

This machine consists of a circular platform, with hollow trunks extending down from it to the top of a revolving plate, containing the moulds and pistons. The shaft of this revolving plate passes up through the centre of the platform, and at the top it receives, and gives motion to, a spindle, the arms of which carry the tempered clay into the hollow trunks, through which it is conducted to the moulds in the plate below. As the plate revolves, the moulds are brought under the trunks, and receive the clay, and as they move on they pass under an arm, which is jointed to the shaft of the plate, and which, by a catch, becomes united to, and moves around a portion of the circuit with the mould, thus constituting its top. During this portion of the circuit the piston is forced up against the arm, or false top, by passing over a circular cam below the plate, and as soon as the brick is pressed the catch disengages the arm, which is carried back by a spring to the side of one of the trunks, to be ready for the next mould; as soon as the mould is relieved of the arm, the piston is forced up by an elevation on the cam, which discharges the brick. There may be any number of moulds and trunks, there being one arm for each trunk.

The claim is to "constructing the platform with vertical trunks, in combination with the revolving spindle. Also the movable arm, in combination with the revolving plate and stationary cam, (which disengages the arm from the mould,) the arm being connected to the plate, and revolving with it while the brick is being pressed, and being detached from it as soon as the pressure is completed, as described."

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19. For an instrument for *Delineating Maps, Charts, &c.;* Amity Bailey, Newburg, South Carolina, September 4.

This instrument consists of a parallel ruler attached to a ring, which revolves with a graduated circle, divided into degrees, and parts of degrees. Each end of one of the rules is attached to the ring, the other being at liberty.

The claim is confined to the "parallel ruler, in combination with the ring and graduated circle," for the purpose, and in the manner described.

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20. For an improvement in the *Paddle Wheel for Propelling Boats;* Francis W. Stevens, Chigwell, Essex county, England, September 5.

This patent is obtained for an improvement on that kind of paddle wheels which has the floats inclined at an angle of from thirty to sixty degrees; the improvement consists in a method of adjusting and changing the angle at any time. Each paddle is affixed to, and revolves on a radial axle, the outer end thereof being supported by a ring. The mode of attaching the paddles to their radial axles is by boxes, so as to allow the paddle to revolve; but when the proper and desired angle has been attained, the boxes are to be screwed tight; the outer angles of the paddles on each side are then jointed to a ring, or a series of braces, so as to retain them at the desired inclination.

The claim is to the "arrangement of the wheel, and of the floats, or propellers, by which their adjustment is effected, in the manner, and for the purpose described."

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21. For a mode of *Cutting Grass under Water;* Jacob Hinds, Hindsborough, Orleans county, New York, September 5.

Two scythes are attached by their heels to a bar of iron, which forms a handle—the scythes diverge in nearly opposite directions, so that their points will be about six feet apart. The handle is held by a person at the stern of a boat, the scythes dragging on the bottom, and as the boat moves they cut the grass.

Claim.—"I do not claim to be the inventor of the scythe, but what I do claim is the connecting of two scythes at their heels, and to a bar of iron, &c., for the purpose, and in the manner described."

22. For an improvement in *Door, and other Locks;* Augustus Prutzman, Philadelphia, Pennsylvania, September 5.

In this lock the same bolt is used for a spring latch and lock bolt, and when employed as the latter it is shot out farther than when used as the former. The bit of the key contains a set of levers, or tumblers, operated upon, and thrown into their proper position by a slide, or slides, actuated by a small additional key, which enters the barrel of the main key. Each lever is provided with a notch corresponding with a notch in the bit of the key, which latter cannot turn until, by the proper application of the small key, they are all made to coincide.

The bolt, when employed as a latch bolt, is actuated by a right angled lever, on which the cams of the knobs severally act, and when the bolt is to be thrown back it acts against one end of the tumbler, which is jointed to the bolt, so that as the tumbler is forced back by the lever the bolt must follow; but when the bolt is shot forward as a lock bolt, the end of the tumbler cannot be acted upon by the lever, and hence the knobs have no effect upon it.

Claim.—"What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have constructed, arranged, and combined the slides and safety levers contained within the parts which I have denominated the barrel and bit, so as to be operated upon respectively by the offsets on the end of the key, by which the notch in said levers are made to coincide with the notch in the bit, thus allowing the bit and barrel to be carried around by means of the key, and the spring bolt to be carried forward, or moved back, as a lock bolt." "I also claim the particular arrangement of the parts which operate upon the bolt as a spring bolt, in combination with each other; said combination consisting of the double, (or right angle,) lever, acted on by both of the cams, or fallers, of the respective knobs, said lever acting upon the bolt through the intermedium of the tumbler, the whole combined and operating substantially in the manner set forth."

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23. For an apparatus for *Containing and Preserving Meat in Market;* Adam Letzer, Baltimore, Maryland, September 5.

This apparatus consists of a refrigerator of the usual construction, having within it two zinc tubs for salting meat, and a bench and "block" placed on trucks, so that when not used it can be wheeled up against the refrigerator, and the two locked together. What the patentee calls a block is a bench, boarded up all around, except on the side towards the refrigerator, and within this the scales, tools, &c., are placed. The claim is to the "combination of the refrigerator, zinc salting tubs, and motive block, for the use of victuallers at the markets, or other places."

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24. For a *Locomotive Cylinder Printing Press;* Charles J. Carr and Andrew Smith, Belper, Derby county, England, September 10.

In this press the form of types is placed upon a permanent bed, and a roller passes over it to give the impression. The roller has its gud-

geons in boxes working in a sliding frame, each end of which is provided with ink-spreading rollers, which receive the ink from an inking apparatus at each end of the machine, when the roller stops, preparatory to returning. The paper is fed in by a system of threads, a delivery board, receiving roller, &c., which conduct the paper between the impression roller and the ink-spreading rollers. There is a peculiar arrangement for registering; but as the whole could not be clearly described within the limits of a notice, and as the claims refer to, and could not be understood without drawings, we will merely add that the claims are limited, first, to the peculiar arrangement of parts for supplying, conducting, and delivering the paper; secondly, to an improvement in the inking apparatus, by which it is adapted to the peculiar structure of the machine, and thirdly, for an arrangement of the parts for effecting a register, as in book, or other work.

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25. For a method of *Uniting Canal Boats when made in Sections;* Robert Frazer, Waynesburgh, Mifflin county, Pennsylvania, September 10.

The boat is made in sections, each section being water-tight. The sections are to be united together two abreast, and three in a line, by means of iron yokes, which embrace the bows and sterns, and by eyes and staples for the middle sections. The bow and stern sections are so formed that when two are put side by side they constitute a proper bow and stern.

Claim.—"What I claim, and desire to secure by letters patent, consists first in placing the boats two abreast; and second—the mode of fastening the sections together when floating, by the yokes and screws, as described."

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26. For an improvement in the *Brake for Railroad Carriages;* Peter J. O. Conway, Philadelphia, Pennsylvania, September 10.

This brake consists of a shoe which is to be pressed against the tread of the wheel and the rail. It is suspended to a spring bar of metal which is attached to the frame of the carriage, and curved over the wheel. The brake is pressed against the wheel and rail by means of a lever jointed to it, and extending up so as to be within the reach of the tender, and when liberated it is drawn up by the spring. Claim—"I do not claim to be the inventor of a brake, or drag, in which the shoe presses against the road and the periphery of the wheel at the same time, this having been known and used before, but I do claim as my invention attaching the shoe to a spring bar, in the manner, and for the purpose specified."

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27. For an improvement in the *Spark Arrester;* Leonard Phleger, Philadelphia, Pennsylvania, September 10.

Outside of the common chimney is a casing extending from the top of the boiler to about eighteen inches above the top of the chimney, the lower half being cylindrical, and the upper spreading out

conically, leaving a space between the two, which is occupied by a perforated case, the lower portion of which is cylindrical, and the upper part conical, to correspond with the outside casing, excepting about a foot of the upper part, which is cylindrical, and not perforated. The top of the arrester is closed, excepting a hole in the middle, equal in diameter to that of the chimney, which opening is provided with a conical cover, so hinged to it as that when closed the apex of the cone will be downwards, and immediately over the centre of the chimney. The bottom of the perforated tube extends to within a foot or two of the bottom of the chimney, where the space between it and the outside casing is closed by a plate, and the space between it and the chimney is left open. From the space between the chimney and the outside case, below the perforated tube, an elbow pipe extends to a box for the reception of the sparks. The outside casing is provided with a number of elbow pipes of different lengths, opening into the space between the outside casing and the perforated tube above and below, there being two sets, one long, and one short.

The patentee thus describes the operation. "When the engine is in operation the cover is to be fastened down by means of a loop on the end of a rod. The operation will then be as follows. After the heated air, sparks, and steam, have passed up the flue, or chimney, the direction of the draught is turned downwards, between the chimney and the perforated cone; the sparks have but little tendency to pass through the perforations, but are driven down, with a portion of the steam, into the space, and thence through the elbow pipe into the receptacle, where, by the closeness of the receptacle and the action of the steam, they are soon extinguished. The gaseous products of combustion pass through the perforations into the flue space surrounding them, and through this, and the double elbow pipes, into the atmosphere. What I claim, &c., is the forcing of the sparks to descend between the flue and the perforated cone into the space, and thence through the pipe into the spark receptacle, in the manner, and in consequence of the combined operation of the respective parts, constructed as set forth."

"I also claim the forming of the flue space on the outside of the perforated cone, constructed as described, by combining with the space between said cone and the exterior case, a number of pipes, or tubes, in the manner, and for the purpose set forth."

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28. For an improvement in the *Corn Cultivator;* Noah Barnes, Easthampton, Suffolk county, New York, September 10.

This improvement in the cultivator consists in a long share, which extends from a point where the coulter and a land-side are united, to the back; the land-side and share forming an acute angle. The two consist each of a narrow bar of iron, the latter being sharp at one edge. They are attached to a triangular frame, one side of which projects sufficiently beyond the triangle to form the beam. To the back piece of the frame, which forms one side of the triangle, and to an intermediate cross piece, teeth, similar to harrow teeth, are at-

tached. The land-side, or bar, is placed under that side of the triangular frame which forms the beam. The claim is to the "combination of the share, teeth, and frame."

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29. For an improvement in the *Alarm for Time Pieces;* Benjamin Knight, Slatersville, Providence, Rhode Island, September 10.

This alarm is to be started by a detent on the arbor of the minute hand, which, at every revolution, lifts a lever, to which is suspended a rod, having a hook at its lower end that catches on to the teeth of a wheel, and at each operation carries it around one tooth. This wheel has twenty-four teeth; and on its face it is divided into as many parts, marked in two series, from one to twelve, there being a hole on the face to correspond with each division, into which a pin may be inserted. The pin is inserted in the hole corresponding with the hour at which it is to give the alarm. The wheel is turned one notch at each hour, and at the given hour the pin lifts a lever, and this a second lever, which is weighted, and is connected by means of wires and bell cranks with the bell, which is to be rung.

The claim refers to the drawings, and is limited to the arrangement and combination of the parts consisting of the detent on the arbor of the minute hand, the rod which actuates the notched wheel, the latch lever, and the weighted lever, as described.

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30. For a machine for *Cutting Staves;* Cephas Manning, Acton, Middlesex county, Massachusetts, September 10.

In this machine the knife is curved in the direction of its cut, so as to cut staves suited to the diameter of the barrel; the knife is attached to two blocks, one at each end, which slide in curved grooves in the frame, instead of being attached to two heads working on an axis; the knife is actuated by a lever. The claim is to the arrangement above described.

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31. For a machine for *Dressing Cotton Waste and Rags,* previous to the same being reduced by the cutting machine and common duster; Emery Smith, North Sudbury, Middlesex county, Massachusetts, September 10.

This machine consists of a cylinder, with two rows of double pointed teeth on opposite sides, so arranged that the teeth in one row shall be opposite the spaces between the teeth in the other row; these teeth are all curved in the same direction. A row of wire teeth projects from the side of the case in which the cylinder revolves, and these are so arranged that the point of each tooth will pass between the forks of the teeth on the cylinder as it revolves. A wire concave is placed below, sufficiently low to avoid the teeth on the cylinder. The cylinder is provided with two fast and loose pullies, and with two straps, by means of which it may be made to revolve in opposite directions.

The claim is to the cylinder with angular forked teeth, in combination with the teeth in the case and the wire concave.

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32. For a *Sugar Mill;* Nathan Sargent, Cambridge, Middlesex county, Massachusetts, September 10.

The sugar is ground by a cylinder armed with rows of teeth which run spirally around one half of its circumference in one direction, and in the reverse direction on the other half. The teeth are thus arranged to enable a scraper to scrape away the sugar which adheres to the surface of the cylinder between their rows; this scraper is placed in slides below the cylinder, and is notched, to correspond with the rows of teeth. As the cylinder revolves, the teeth come into contact, in succession, with the whole surface of the sugar in the hopper, and the scraper removes that which adheres between the rows of teeth, said scraper receiving a reciprocating motion from the teeth. Were these arranged in rows in the direction of the circumference, they would not act on the whole surface of the sugar, and if they were arranged in continuous helices the scraper could not act on the surface of the cylinder between the rows of teeth.

Claim.—"I claim a cylinder having its teeth disposed in advancing and receding helices, in combination with a scraper."

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33. For an improvement in the manner of *Attaching Glass Knobs to their Sockets;* Francis Draper, East Cambridge, Middlesex county, Massachusetts, September 10.

The lower part of the knob is made conical, the larger part thereof being towards the socket, a strip of metal is bent around it, and the ends soldered together, and attached to the glass by cement, or other means. This part, thus surrounded with metal, is put into the metallic socket, and the two are then united by soldering.

Claim.—"I claim as my invention, connecting the glass knob to the socket, through the intervention of a conical metallic ring affixed to, and surrounding the lower part of the knob, and soldered to the socket."

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34. For improvements in the mode of *Pressing and Finishing Straw Hats and Bonnets;* William Chaplin, City of New York, September 10.

The top, crown, and brim, of the hat are pressed separately, and for this purpose, press, or dye, blocks of wood, of the proper form, and previously moistened, are used in connection with polished metal matrixes, provided with heaters. For the crown the matrix and block are conical,as are also those for pressing the rims and fronts,and for the top, of any form to suit the fashion. The block and matrix are placed, with the article to be pressed between them, in a hand press, very similar to the common hand printing press.

Claim.—"First—the application of countersunk heated metal disks,

for pressing and finishing the crown tops of hats and bonnets, in combination with the dye block, as described."

"Second.—The mode of forming the conical matrixes and heater boxes with heaters, and the combination of the same with the conical dye block, when such combination is applied to pressing and finishing the sides of bonnet, or hat, crowns, as described."

"Third.—The employment of the conical dye block for pressing the brims, or fronts, and also the employment of paste board, to give equal pressure, as described."

"Fourth.—The mode of forming the conical matrixes and heater boxes with heaters, for pressing bonnet, or hat fronts, or brims, and the combination thereof with the curved conical dye block, when such combination is employed for the purpose of pressing bonnet, or hat fronts, or brims, or articles of a similar nature, made of vegetable substances, as herein described."

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35. For a *Machine for Cutting Staves;* Oliver Sheldon, New Marlborough, Berkshire county, Massachusetts, September 10.

The improvement is on that kind of stave cutting machines, that cut by means of a knife attached to two heads on a shaft, the knife being curved in the direction of the cut, so as to give to the stave the proper form for the diameter of the barrel; the improvement consists in attaching to two arms on the shaft, to which the stave cutting knife is attached, two sets of cutters for forming the champher and groove at each end of the stave, and for cutting off their ends. The claim is confined to these cutters in combination with the revolving knife for cutting the stave.

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36. For an improvement in the *Machine for Cutting Staves;* Caphas Manning, Acton, Middlesex county, Massachusetts, September 14.

This machine cuts a stave in a manner similar to that noticed in the preceding article, but without the improvement therein mentioned as the subject of the claim. The improvement claimed in this patent consists in combining with the revolving cutter for cutting staves a mode of working the carriage to feed the block up for every stave cut. In the machine described two cutters are used.—The block of wood is properly attached to a carriage by means of dogs—the carriage has a rack under each end into which two pinions on a shaft mash, and is so connected, by means of suitable gear, with the shaft of the cutters that the block is fed up, after one knife has passed through the wood, to receive the cut of the other knife.

The claim is to the "arrangement of the knives in combination with the arrangement of machinery for moving forward the carriage as the staves are cut."

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37. For an improvement in the *Horse Power;* Charles Hibbard, Guilford, Stafford county, New Hampshire, September 14.

Two vertical shafts placed at a considerable distance apart, have a

band or rope passing around them, to which the horse, or horses, are attached, so that they draw in a straight line except in passing around the wheel at each end. From one of the shafts the power is communicated by means of bands and band wheels to the machinery to be driven. The claim is confined to this device.

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38. For an improvement in the *Two Wheeled Carriages, called Cabs;* John Page, New York city, September 14.

The improvement in this cab consists, first, in carrying a bent axle along the sides and around the front or back of the body; and when carried around the back, in bending it down so as to pass under the door, and in attaching the shafts to the bent part of the axle, and connecting the body of the carriage with the bent axle by means of the springs only; and secondly, in arranging the seats diagonally and in having the door in one of the corners so that two persons can sit in a less space than when the seats are ranged entirely across.

Claim.—"What I claim is the manner in which I have combined and arranged the bent axle, the shafts, the springs and the body of the carriage, or cab, with each other, the bent axle being carried either in the front of or behind the body, as herein set forth. I also claim in combination therewith, the manner in which I have arranged the seats and the door, by placing the former in opposite corners and the latter on one side, as set forth."

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39. For *Key Bands for Tobacco Casks;* James M. Talbott, Richmond, Virginia, September 14.

This band has a plate on one end with a mortise through which passes a tongue attached to the other end of the band—the tongue also has a mortise in it through which passes a key by which the band is drawn tight after it has been put on the cask.

Claim.—"What I claim as my invention is constructing the key band with a mortise plate in combination with the tongue and wedge."

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40. For a machine for *Extracting Stumps;* Lewis and Charles Howard, Reading, Steuben county, New York, September 14.

A chain made fast to the stump is attached to, and winds on a windlass or shaft on which there are two ratchet or rag wheels which are actuated by two hands worked by combinations of levers, there being three levers in each combination. At the end of the frame of the machine towards the stump, two large pieces of timber called anchors, and properly shod, are hung by hinges, and these are forced into the ground and prevent the machine from being drawn towards the stump.

Claim.—"What we claim as our invention and desire to secure by letters patent, is the manner in which we have arranged the levers, in connection with the machine, and their further combination with the bands, wheels, anchors and chain."

41. For improvements in the *Floating Dry Dock;* John L. Gilbert, New York city, September 19.

This floating dry dock is so constructed that it may be used either for the purpose of repairing vessels or for floating them over bars or shoals. It is constructed with water tight cases, or trunks, on each side of the body, or floating chamber, of the dock, and these are divided transversly by means of water tight bulkheads; the whole of these are connected with each other, and with a pump well, by means of pipes governed by cocks, so that water can be let into, or pumped out of any or all of them by means of a steam engine, which may also be used for pumping the water out of the body of the dock, and for propelling it when used for floating vessels over shoals, &c.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the combination of the body of the dock in which a ship can float, with water tight trunks, or tanks, at the sides separated by water tight bulkheads, for the purpose and in the manner set forth."

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42. For improvements in the *Cooking Stove;* James Still, Zanesville, Muskingum county, Ohio, September 19.

In this stove the flue passes over the top and under the bottom, and up the back of the oven, the draught being caused to pass along both flues at the same time by extending the top plate back so as to divide the collar, which receives the stove pipe, into two parts. A hole is made in the bottom plate of the stove opening into the bottom flue and is provided with an ash box into which the dust falls in cleaning out the stove.

Claim.—"First, the mode of forming a double draught by extending the top plate of the oven back so as to divide the collar to which the smoke pipe is attached into two parts, for the purpose of allowing a draught above and below the oven at the same time, as described. Second, constructing a flue under the oven with an opening at its bottom and adapting thereto a movable box, as set forth."

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43. For a *Machine for Cleaning Grain;* Edward Bradfield, Rochester, Monroe county, New York, September 19.

Within a cylindrical casing, formed of wood or iron ribs, and of wire gauze, what the patentee denominates a beating cylinder, is made to revolve; this cylinder is constructed by extending arms radially from a vertical shaft at its middle and near its two ends, by affixing a hoop or ring to the ends of these arms, by covering the two end hoops with wire gauze, and by securing to the edges of these hoops four metallic plates, having their edges turned at right angles so as to stand out radially; these plates have teeth cut on them, and are so tempered as to give them elasticity. Between each of these plates there is another plate running from end to end of the beater cylinder, its edge standing out radially and as far from the center of the shaft as the point of the teeth on the first named plates. A plate of metal is placed on the shaft, below the lower disc, or end, which

plate is made to form vanes, which force a current of air up into the beater cylinder. The grain is fed in at the top, and in descending it is operated upon by the beaters and the current of air.

Claim.—"What I claim as my invention and desire to secure by letters patent is, the constructing of the revolving cylinder with elastic teeth, as herein set forth; also in combination with the above, the radial plate at the bottom of the machine, in which is combined their self regulating power, so as to effect the greatest possible good for the purpose intended."

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44. For improvements in the *Coffee Mill;* L. R. Livingston and Calvin Adams, Pittsburg, Pennsylvania, September 25.

This mill is of the old fashioned kind, with a nut revolving in a shell, and the improvements claimed are three in number. The first consists in a mode of casting the hopper, shell and arch piece in one piece. From that part of the hopper where the shell commences three pieces rise, approaching each other until they unite in a collar for the spindle to work in. The second, is the mode of attaching the mill to a table, or shelf, by means of a projecting plate, cast with the hopper, and with jogs on its under side to stick into the wood, and a hook which catches against the underside of the table, or shelf, the shank of which passes through a hole in the plate, and receives a nut on its end by which the plate and hook are drawn tight together, embracing the table or shelf between them. The third improvement is in a method of regulating the cut of the mill—this is effected by passing the spindle of the nut, or cylinder, through the collar of the arch, and instead of letting the handle rest against a shoulder on the spindle, it bears on the top of the collar—the thumb nut which screws on to the end of the spindle, draws the grinder up, in consequence of the handle resting on the collar of the arch. Or the same thing may be effected by attaching the handle to the spindle permanently and having a thumb screw to pass through the handle and rest on the collar of the arch. The claim is confined to these devices.

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45. For an improvement in *Door Locks;* Peter Rogers, Philadelphia, Pennsylvania, September 25.

The patentee says—"the improvement consists in the manner in which I construct and combine the spindle and knobs of the spring bolt with the fallers, or followers, which operate upon the lever and retract the bolt so as to simplify the structure of this part, and improve its action. I construct the inside faller, or that which is next to the lock plate, with a hollow barrel, or cylindrical socket, which projects out from the face of the lock plate, upon which barrel, or cylindrical socket, I fit the inside knob of the spring bolt. The knob spindle is made cylindrical where it passes through the inside faller and into said barrel, and has a groove turned in it to receive the point of a screw which passes through the inner knob, and through the barrel, attaching them together, and holding the knob spindle in place."

Claim.—"I claim the constructing, combining, and arranging of the

socket, the inner faller and the inner knob, in the manner and for the purpose herein set forth, so that the two knobs may act independently of each other. I do not claim the mere making of the inner knob to act upon the spring bolt independently of the outer knob, this having been done in other modes, but I limit my claim to the effecting this object substantially in the manner made known."

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46. For a *Self Acting Mule for Spinning Cotton;* Daniel P. Lapham, administrator of Benjamin Lapham, Adams, Berkshire county, Massachusetts, September 25.

This is of necessity a complex machine, the description of which runs through thirteen pages of folio, with numerous drawing. An attempt to give even an account of its characteristics would lead us far beyond our limits, and without the aid of drawings it would be useless to attempt a description of it. We are under the necessity of omitting the claims as they refer throughout to the drawings and could not be understood without them.

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47. For a *Cotton Press;* James A. Potter and James E. Kelsey, the former of Providence, Rhode Island, and the latter of Poughkeepsie, New York, September 25.

This press consists principally of two endless chain platforms somewhat similar to those made for endless chain horse powers, these platforms are so arranged, one above the other, that at one end they approach more nearly together than at the other:—their distance apart being regulated at pleasure. The bale which is to be repacked is received between them at the end where they are farthest apart, and in passing through as the platforms revolve, it is compressed. This machine is intended only for repressing bales of cotton, hay, &c., for the purpose of making them occupy less room in stowing on board ship—and it is made portable so that it can be taken to a wharf when a vessel is to be loaded.

Claim.—"What we claim as our invention is the employment of two revolving endless chain platforms so constructed as that they shall be nearer together at one end than they are at the other, &c., as described."

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48. For improvements in the *Cooking Stove;* Samuel L. Chase, Woodstock, Windsor county, Vermont, September 25.

In this stove there are two, three, or more ovens, and these are arranged two in height with a flue between them. The draught passes out from the fire chamber into the flue between the top and bottom ovens, then over the upper oven, or ovens, thence down one end to the flue under the lower oven, or ovens, thence to a rarefying flue under the fire chamber (to insure a draught) and out at the exit pipe. The hearth in front of the fire chamber is sunk, and is provided with bars, for coal, and holes below the bars for draught, it is also provided with a cover, having holes for boiling, &c., which is hinged so as to swing

off and on. That part of the cover on the sunk hearth which runs along below the door of the fire chamber is notched, and the bottom of the side door is provided with an inclined piece, the two forming a flue, from the coal undergoing combustion in the sunk hearth. The cover of the hearth may be made in two parts, each half being hinged so as to swing off on the two sides of the stove.

Claim.—"Having thus fully described the nature of my improvement, and shown how the same is carried into operation, and having in so doing shown and described many parts and devices, of which I do not claim to be the inventor, I now proceed to state what I do claim, and desire to secure by letters patent, viz: first, the manner in which I have combined and arranged the flues, including the rarefier as set forth, that is to say the admitting of the heated air from the fire chamber into the flue between the upper and lower ovens, conducting it thence through the flue above the upper oven, thence through the flue at one end to the flue under the lower oven, thence into the rarefying flue under the fire chamber, and thence into the exit pipe, all as herein made known. Secondly, I claim in combination, the arrangement of the respective parts of the hearth for boiling and other cooking operations, which arrangement consists of the sunk hearth furnished with the bars, the openings for the admission of air, the swinging hearth, and the flue formed by the notch in said hearth, and the sloping projection at the lower edge of the furnace door, as described."

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49. For a *Cot, or Cross Bedstead Sofa;* Girard Sickles, Middletown, Middlesex county, Connecticut, September 25.

The following is the claim on which this patent was granted, viz: "What I claim is the contrivance of converting a common cot, or cross bedstead, into the shape of a sofa, or settee, and vice versa, by means of an additional joint in the upper part of one of the cross stanchions, or legs, at each end of the cot, combined with arms and frontispieces, all constructed, fitted, and adapted to each other as described."

When the sofa is used as a beadstead the jointed stanchion is straight, a cloth, sacking, or leather bottom is stretched from a bar running from the upper ends of the two stanchions on one side, to the bar on the upper end of the stanchion on the other, in the manner of a common cot bedstead. When it is used as a sofa, the jointed end of the two stanchions, which are in the front of the sofa, turn down and form the fronts of pillasters; this brings the bar, to which the sacking is attached, down to the proper height for a seat, and the sacking lies in a proper curve to form the seat and back, the bar on the other stanchions being elevated by this change. The necessary means are provided for locking the parts in their proper position, and for ornamenting the article.

Specifications of American Patents.

Specification of a Patent for an Improvement in the Construction of Railroad Switches. Granted to Nathaniel Eaton, *of Worcester, Massachusetts, on the 3rd of September,* 1840.

Be it known that I, Nathaniel Eaton, of Worcester, in the county of Worcester, and state of Massachusetts, merchant, have invented a new and useful improvement in the construction of railroad switches, called "Eaton's Improved Railroad Switch," of which the following is a full and exact description.

The improvement is applied to the railroad switch in common use, which is formed by two rails connected by transverse rods of iron, and which may be shifted from one set of permanent rails to meet those of a different track, by means of a lever. The improved switch is made with two, or more rails, to accommodate to the number of tracks or diverging rails, which may be used. It may be placed on a platform of wood, or metal, over the superstructure of the road, or may have the rails connected together by iron rods, with screws and nuts to hold each of the rails in their places, and to adjust them in case of any change of position, occasioned by accident, or by the variation of temperature. The improved switch is constructed with two, or more rails. On the outside are placed two rails, commencing at the end next to the chair in which they rest, or the hinge by which they are shipped; these rails are formed like the common rails of the road; they are straight, until they reach about to the middle of the length of the switch, and are then bent slightly outwards. Within these outer rails, and at such distance within them as to admit the passing of the flanch of the car wheel, is fixed another rail; this is fastened to the head of the switch by a bolt, on which it turns as upon a pivot; it is formed of the usual thickness and size of the road rail, for about three or four feet from the head, and then tapers on the side to an edge, or point, having a wedge shape. This is called the safety rail; and is of such length, and tapers in such manner, as that when the small end is pressed against the outer rail, where that curves outward, that the inner surface of the safety rail forms a straight line with the permanent track. This safety rail is pressed strongly against the inner face of the outer rail by a spring placed so low beneath the upper surface of the rail as to lie beneath the flanch of the car wheel, or it may be bolted to the outer rail, or so secured by the other attachment as to act against the safety rail, and to bring it in contact with the outer rail. The safety rail may slide on smooth iron plates, or be moved on friction rollers, or on rods of iron connecting the rails together.

On the inside of the safety rail is fixed another rail, shaped like a wedge, tapering on the sides to an edge, two or three feet long, and continuing the permanent rail. This rail is bolted at the head of the switch; beyond it, extending towards the hinge end of the switch, is

a guard rail of the common form, to guide the wheels on the track, and prevent their striking against the edge of the safety rail.

The construction of the improved switch, which has been described, is fitted for only two permanent tracks; but the switch may be adapted to any required number of tracks, by increasing the number of rails on the switch, and providing a safety rail and spring for each additional set of rails, in the manner before described.

The switch is moved and regulated by the lever and rod applied to the common switch.

In the use of the improved switch the safety rail is placed against either of the main, or diverging tracks of the railroad, and at least two of the permanent rails are covered. As the cars proceed in the direction from the hinge to the head of the switch, they will be directed on the track covered by the safety rail, and will be prevented from running off from the rails; when they move in the opposite direction, they must be carried upon the permanent rails, because the end of each of those rails is covered and continued by the switch rails. Although the switch may not have been moved, the flanch of the car wheel, if running on the outer rail, will move the safety rail so far as to admit of the free passage of the cars, and after the train shall have passed the spring will restore the safety rail to its place.

The accidents which have occurred in the old mode of constructing, cannot occur in the improved mode of building switches, which has been specified; for the safety rail, adjusting itself, will always furnish a continuous line, and prevent the cars from running off from the track. Another great advantage of the safety rail is, that the cars on many diverging tracks, will be carried upon one line of rails without the care and labour of adjusting the switch for each. What the said Eaton claims, and desires to secure by letters patent, is the mode of constructing switches with a movable rail, operating by a spring, or weight, or otherwise adjusted, in the manner before described, so as to cover two, or more, permanent railroad tracks.

NATHANIEL EATON.

Specification of a Patent for a Means of Producing Adhesion between the wheels of Locomotive Engines and the rails of railway tracks. Granted to JORDAN L. MOTT, *of the city of New York.*

To all whom it may concern: Be it known that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented a new and useful method, or apparatus, for the purpose of producing adhesion between the wheels of locomotive steam engines and the rails of railway tracks, by which device such engines will be enabled to overcome the resistance arising from ascending grades without its being necessary to throw any additional weight upon the wheels for that purpose, and I do hereby declare that the following is a full and exact description thereof.

My improvement consists in the combined application of moisture and of sand to the wheels, by means of which the sand may be dis-

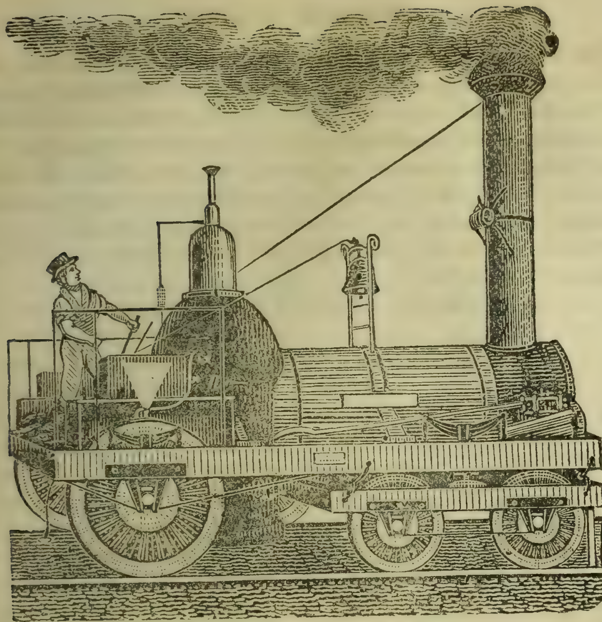


Fig. 1.

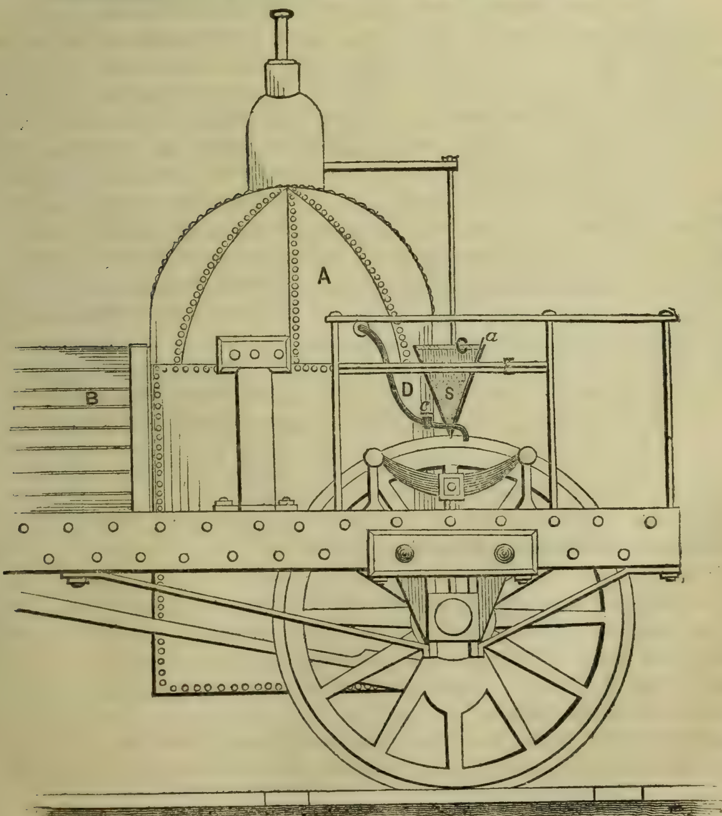
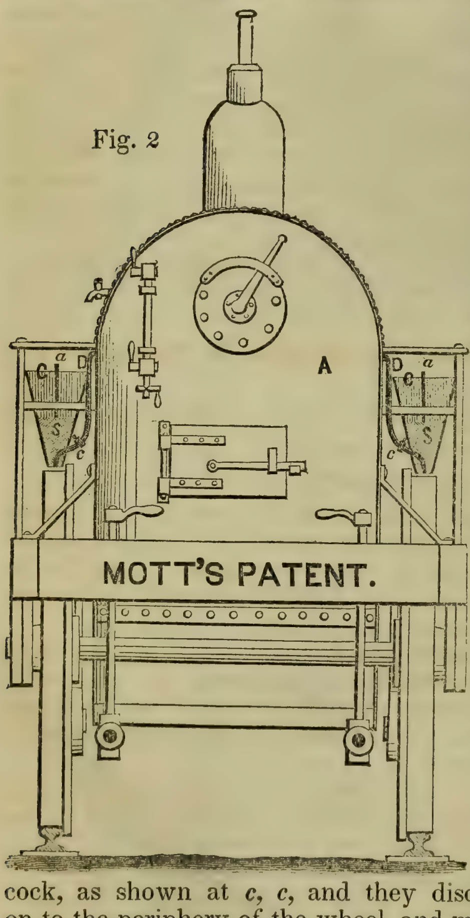


Fig. 3.

tributed over the surface of the tire, or tread of the wheels, and will be made to adhere with sufficient force, and in sufficient quantity, to produce the required adhesion. In the accompanying drawings, fig. 1, is a perspective representation of a locomotive steam engine and carriage, having two driving, and four truck wheels, to the former of which my apparatus is applied; its application, however, is not limited to locomotives of any particular construction, but is equally adapted to those with four, six, or eight driving wheels; fig. 2 is an end view, and fig. 3 a side view, of such part of a locomotive as is requisite to show the manner of applying my apparatus. A, is the steam chamber, and B, the body of the boiler, which may be constructed in any of the ordinary forms; *c, c,* are hoppers, or boxes, for containing sand, the lower portions, *s*, of which boxes are to be charged with this material in a dry state. These hoppers may be varied in situation, but I, in general, place them directly over the centres of the driving wheels; the sand is to be discharged from them through a tube, or opening, at their lower ends, which opening is governed by a valve, or sliding shutter, by which it can be properly regulated; *a*, represents the handle of such a valve, or sliding shutter, which may be constructed and managed in any of the known ways of constructing and managing devices of this kind; D, D, are steam, or water pipes, which are to convey the moisture to the wheel from the steam chamber, boiler, or other source. These pipes are to be governed by a stop cock, as shown at *c, c,* and they discharge the water, or steam, on to the periphery of the wheel, and moisten it directly in advance of the aperture for the discharge of sand; if steam is used, it will be condensed upon the wheel, but it will probably be found to economize heat by using water. The quantity expended in either case will not, however, be important in amount. Instead of using the water, or steam, from the boiler, water may be conducted through the pipes from a cistern, or reservoir, of cold water, placed in any convenient situation for

Fig. 2



that purpose. Although I prefer to discharge the sand and moisture upon the wheels, it will be manifest that they may be directed with like effect on to the rails in advance of the driving wheels, and that the combined operation of the moisture and sand will be the same, but the apparatus will, in this case, have to be extended, without producing a corresponding advantage.

Having thus fully described the nature of my invention, and shown how the same may be carried into operation, what I claim as new, and desire to secure by letters patent, is the applying of sand to the peripheries of the driving wheels of locomotive engines, in combination with the application of water, or steam, to moisten the wheels, for the purpose of causing the sand to adhere thereto, substantially in the manner set forth, and so as to enable such locomotives to ascend inclined planes, or elevations, on a railroad, in consequence of the friction produced by such application; I claim also the applying of moisture and sand simultaneously to the tops of the rails in advance of the driving wheels, considering this mode of applying the moisture and sand as a mere modification of the general principle upon which the utility of my invention is dependent.

Jordan L. Mott.

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. Boucherie, M. D.

[continued from page 286.]

Is the Penetration always complete?

In the white woods we find a central tube of variable diameter, which resists impregnation; in the hard wood, it is the most central part of the heart which remains in its natural state. This fact is worthy of attention, and appears to me, fruitful in results, both in regard to practical applications, and to physiology.

In the white woods, this central part is known to those who work in wood, as presenting the least resistance, and being the most easily decayed. • It does not become impregnated, because it has no longer a circulation, or life; it is dead wood, placed in the midst of wood perfectly alive.

Many observations confirm this view of the subject, which may lead us to learn more accurately the qualities of wood. Thus I have found that this non-impregnation appears elsewhere than at the centres of the stems. It is found disseminated in all possible forms, and to a variable extent, in different parts of the same stem. Alongside of a band, the fibres of which are perfectly impregnated, will be found another band, whose fibres are not affected, and this occurrence is very often repeated in the same stem. What is the cause of this? A little attention will suffice actually to show it to us in the greater number of cases, and to deduce it by reasoning when it is not evident.

These accidents are always due to some obstacle in the circulation, and almost always, at the base of the bundles not impregnated, we

will find a knot, or a decay. No movement can then be produced during the life of these parts of the stem, and it is not astonishing that we cannot succeed in impregnating them after the tree is cut. It is, I repeat, dead wood, which must be destroyed more rapidly than the wood around it, since it has been for a long time subject to the influences which destroy all organic substances. I am aware of the boldness of such an opinion, but I also see how curious will be the experiments made to confirm, or destroy, it. I call attention to it.

This irregularity of the penetration gives rise to very remarkable peculiarities; I have pieces of wood which owe to it the appearance of marble.*

As to the non-penetration of the most central parts of the heart of oak, elm, &c., I consider it also as a proof that the circulatory movement has for a long time ceased there; it is again, dead matter, placed in the midst of wood full of life. A number of persons will contradict this proposition, for the heart of oak is generally considered as the part of the wood which presents the greatest resistance.

In order to answer this objection, I will make one remark, and quote a single fact.

The fact, I owe to M. Emery, ingenieur en chef des ponts et chaussès, he informs me that in a structure of oak wood, he observed that all the pieces, in other respects sound, or nearly so, upon their exterior, were completely worm-eaten in their central parts, and that this alteration always occurred in oak wood under the same circumstances.

The remark is as follows; in the ordinary distinction which we draw between the sap wood and heart of oak, we ground it upon the difference of colour, which is presented by a section perpendicular to the axis. All that is white, or nearly so, is sap wood; all that is dark, is heart wood. Admitting the distinction, and drawing it in the same way, there is no doubt but that the sap wood is far more alterable than the heart; but the difference is not the same when we ground it upon the fact of penetration, and consider as sap wood all that is impregnated, and as heart, all which resists. The sap wood then approaches much nearer to the centre, and constitutes three-fourths of the mass of the wood.† And it may well be the penetrable substance alone, in which the circulatory movement existed, which presents this resistance to alteration; it is probably for want of careful observations that it has been admitted that the central part of the heart possesses properties which do not exist in the intermediate and living parts which are interposed between the heart and the sap wood. In

* This central portion, this heart of white woods, varies according to age, in regard to the volume of the tree which it occupies. In trees of great age, it is larger in proportion, than in those more young. I experimented upon a pine tree eighty-five years old, in which it represented one-fifth of the cube of the wood.

† All hard woods do not resemble each other, in regard to the volume of impenetrable heart wood, as compared with the parts which it is possible to impregnate. Thus, in sea-side oaks, experiment has proved that we may succeed in penetrating three-fourths of the mass. I have found other oaks, growing on the same soil, of which not more than one-ten h could be impregnated. The season in which they were cut, it is true, was not the same, but I have not yet been able to determine whether the season was the only cause of the differences.

this case also, in order to form a definite opinion, we must have recourse to new experiments.

I will close this enumeration of all the most remarkable facts connected with the penetration of wood, by quoting an experiment originating in this course of study; it appears to me to contain excellent elements for the determination of the proper season for cutting wood, for the purpose of preserving it.

It is known that this cutting always takes place in winter; the recommendation to cut wood at this season is founded upon the false idea that trees cut in winter contain less juice than those cut in other seasons. This practice has continued for ages, and nothing indicates a disposition to abandon it; yet I believe it to be essentially pernicious to the preservation of wood, and I think that cutting them in summer, or better still, in autumn, would be infinitely preferable. The following is the experiment, which justifies the boldness of this opinion.

If after having cut a branch, or a small tree, we adapt to its extremity an U shaped tube, having long limbs, and one-fifth filled with water, we will remark a strong sucking action exercised upon the air interposed between the bottom of the branch and the surface of the water. This surface slowly rises, and finally attains a great height, at which it remains stationary when the force of aspiration is exhausted. I have found, to my great astonishment, that the volume of air absorbed is nearly equal to the cubic capacity of the branch itself, when the small twigs had been trimmed off.

This experiment appears to me to speak for itself; a great quantity of air evidently goes to replace the water which escapes from the leaves. Hence I conclude that if the cutting took place in a season when the sap is in movement, and if, contrary to the usual practice, the tree were not deprived of its foliage, this natural and abundant introduction of dry air into the sap vessels, would hasten the action of drying in an extraordinary degree.

Upon Hardness.

I will finish my remarks upon the employment of pyrolignite of iron, by mentioning that it not only insures the preservation of timber, but that its presence adds to its density, and seems to exercise a peculiar action upon the ligneous fibre. It hardens it to such a degree that the wood, when prepared, presents to cutting instruments, or any other mechanical force, a resistance at least double that of its natural state.. Every workman to whom I have given wood of this kind to work has confirmed this observation, (which, I think, is of importance,) by their reiterated complaints of the difficulty of working it.

Of the Flexibility and Elasticity of Wood.

After having completed my researches upon the preservation of timber, I turned my attention to its flexibility and elasticity.

These qualities are particularly sought for in naval constructions; the woods which possess them and which preserve them for the longest time, offer such guarantees of durability and service, that the ship-

builder does not hesitate to pay, for masts of northern fir, five times as much as they would cost if made from our Pyrenean firs, or the pines of our *landes.* If, leaving this important application, we examine the circle of the arts which employ wood, we shall find, almost at every step, the necessity of this flexibility and elasticity, which timber looses more and more as it dries.

I therefore sought the means of developing these qualities, in all degrees, in timber without impairing its strength, so that, independently of those conditions of external moisture which preserve them, they might remain without being subject to any of those influences which cause their disappearance.

Nothing but the study of the causes which produce these excellent qualities, could conduct me to the knowledge of those substances, the introduction of which into the vessels of the wood, would either maintain them or communicate them artificially. I therefore proceeded in this natural way, and confirming every observation by farther experiment, I was led to perceive—

First—that the flexibility and elasticity of wood are generally proportional to the moisture which it retains, that these qualities remain only so long as this moisture continues, so that they may serve to prove its presence, even in the dryest wood, and after long service.

Secondly.—That in numerous exceptions to this rule, they appear to depend upon the organic constitution of the wood.

Thirdly.—That in certain circumstances we may attribute them probably to the composition of the wood with reference to the alkaline salts which it contains.

I have purposely neglected to enter into any scientific explanations for the purpose of justifying my opinions, which, although confirmed by numerous observations and experiments, yet require further confirmation. I am now pursuing these researches on a large scale by experiments which will require time.

I confine myself at present to the consideration of the flexibility and elasticity of wood, in reference to its relation to the moisture which it contains, and I will now point out the means to which I had recourse not only to preserve these qualities but also to augment them to a degree which was truly extraordinary. To obtain this result, it is only necessary to introduce into the wood, by means of its vital absorption, a deliquescent salt, which acts not only as an agent for the preservation of its moisture, but which seems, in addition, to produce the effect of the oily bodies, developing in the wood a degree of pliability, which it by no means exhibits when first cut.

In my first attempts I used the chloride of calcium; (muriate of lime.) This compound is cheap, and I proposed to use it in all cases; but reflecting that a great consumption would perhaps augment the price beyond a reasonable limit, I endeavoured to find a substance still less costly, and was fortunate enough to think of the mother-waters of salt marshes, a product now thrown away, which may hereafter be collected and applied to this purpose—and with another view, which I shall point out. These mother-waters are essentially composed of

deliquescent chlorides, and their production is, we may say, unlimited; they gave me the same results as the chloride of calcium.

Moreover whatever deliquescent salt we may choose, it gives flexibility and elasticity to the wood, to any degree which may be desirable. The effect is but slightly remarked with very dilute solutions, while concentrated solutions render these properties excessive. In one word these qualities are developed in proportion to the state of saturation of the liquids which we employ.

My experiments were chiefly made upon pine, which is perhaps the most brittle of woods. I saturated it with concentrated solutions, and then had it cut into very thin slips.

A slip one-tenth of an inch in thickness, and two feet in length may, without breaking, be twisted in the direction of its length, so as to form a complete helix, or may be made to describe three entire concentric circles. They return immediately to a straight line, when the force ceases to act—after having been prepared for eighteen months these properties had not diminished.

Every thing leads me to believe that these saline solutions will also insure the preservation of the wood; but for greater security I mix with them one-fifth of the pyrolignite of iron.

It was to be feared that paint or varnish could not be applied in a permanent way upon wood thus prepared, but I have convinced myself that they adhere to it with as much force as to ordinary timber.

Circumstances did not permit me to study completely and upon large timber, the comparative resistance of wood thus prepared, but the orders of the ministers of the navy and of public works, are about to furnish me with the means of commencing a series of experiments on a grand scale upon this subject. I am already prepared to assert that when in masses one and a half inches square these timbers are never completely dried under the most intense heat of the sun, not even after months of exposure; the little moisture which they lose during the day, is restored to them at night, and consequently their drying never exceeds certain limits. This fact is interesting, in relation to mast-timbers which in certain latitudes are exposed to a drying which facilitates their breaking.

I will not now dwell upon the assistance which various arts may derive from this discovery, as I wish at present to insist only upon the leading fact of intervascular penetration, and upon the general results which flow from it.*

[TO BE CONTINUED.]

* I cannot refrain from citing a fact, which seems to me to demonstrate that the liquids introduced by the vital absorption, are really enclosed in the interior of vessels, the impermeable walls of which retain them imprisoned, even after the death of the vegetable. Having abandoned to themselves some leaves of the Sycamore, fully developed, and penetrated by strong solutions of chloride of calcium, I was not a little surprised to find that during more than two months, in proportion as the contact of the air with their surface contracted their tissue, and thus tended to diminish the capacity of their vessels, they discharged by their *foot stalks alone* a portion of the matter introduced—if the vessels had been permeable, the liquid, without doubt, instead of following so long a course, would have flowed out at the point where the contraction took place. Leaves less far advanced in their development, the vascular tissue of which, consequently, did not present the same resistance, discharged themselves under the same circumstances, by all the points of their surface.

I will mention, also, that after impregnation with chloride of calcium, these leaves shewed,

Progress of Physical Science.

Deductions from Observations made, and Facts collected on the path of the Brunswick Spout of June 19th, 1835. By JAMES P. ESPY, *Member of the American Philosophical Society. Read April 15th, 1836.*

[CONTINUED FROM PAGE 280.]

From the evidence which I collected during five days which I spent on the Brunswick spout, the following important facts are clearly established.

The spout was suddenly formed about seven and a half miles west of New Brunswick, and terminated as suddenly at Amboy, about seventeen and a half miles from where it began. It traveled a little east of north with a very moderate velocity, probably not more than twenty-five or thirty miles an hour. It appeared to all persons, in whatever direction it was viewed, in the shape of an inverted cone of very dark cloud, or smoke, reaching from a dark cloud above down to the earth.

It prostrated nearly every thing in its path, which was from two hundred to four hundred yards wide; the trees on the north of the central line being thrown with their tops towards the south east, and those on the south of this line with their tops towards the north-east; while those in the central line itself were thrown nearly towards the east, or in the direction of the spout: not one instance being found of the trees being thrown with their tops outwards.

It unroofed the houses, prostrating many of their walls outwards as if by explosion, and tearing up the floors of some whose walls were left standing; and not unfrequently, it lifted frame buildings entire from their foundations.

It carried the joists and rafters, in some instances, to a considerable height, and threw them down on the north side of its path, four hundred yards from the house from which they were taken, almost at right angles to its course, and exactly opposite to the course which the wind must have blown at the ground in the yard, as manifested by the direction in which the trees were lying.

It carried up shingles, boards, hats, books, and branches and leaves of trees, and threw them down on the north side of the spout in a band of several miles wide, terminating on the north east end of Staten Island and fifteen miles from Amboy, where the spout ceased to reach the earth, and twenty-five miles from New Brunswick.

At the time when these materials fell, there fell with them a violent shower of hail and rain, the hail, however, being confined to a few miles in the middle of the band where the heaviest part of the shingles and boards fell.

On each side of this band, particularly on the north, there fell a copious shower of rain, mingled with shingles; and even beyond the

eighteen months after preparation, a strength at least equal to that which they had when upon the tree. This tends to shew that the presence of chloride of calcium does not in any way diminish the strength of the vegetable tissues.

borders of the rain, on the north east, small branches and leaves of trees fell in New York Bay, and in North River, opposite to the city of New York.

There was no rain nor hail on the path of the spout, nor on the south side of it; it began about a mile on the north side, increasing in quantity to the middle of the band where the hail was, and then gradually diminishing again as it approached the northern and eastern boundary.

The spout lasted only for a few seconds in a place, and was immediately before, and after, nearly calm, and its effects were hardly felt a few hundred yards off to either side. The noise which accompanied it was every where described as very alarming, not like any thing heard before, more like the rumbling of a great many carriages than any thing else, or, as one man expressed himself, like an earthquake in the air. In Staten Island, as to the length of time this noise was heard previous to the commencement of the hail and rain, the evidence varies from fifteen minutes to an hour, and as to the length of time the shower was falling, it varies from eight minutes to thirty or forty.

Though there was no rain in the path of the spout, the cloud, or mist, of which it was composed, must have been very humid, as the grave stones at Piscataway were covered on the west side with a coat of mud, and in many places the grass and leaves which lodged in masses on the west side of trees which were left standing were clotted together with mud, as if they had been drifted there by an inundation, and several persons that were caught in the spout were entirely covered with mud, so that they could not be known by their friends. There were some lightning and thunder attending the meteor, but not much unless the continual rumbling, or roar, was produced by it, which is not very likely, as a great many who heard the rumbling did not even see lightning.

The wind, probably in the whole length of the spout, certainly in many places, began to blow on the northern half of the spout from the N. E., and on the southern half of the spout from the S. E.; for materials were found which had been moved in that direction first, and afterwards carried back even beyond their original position by the hinder part of the spout, which appears, in all cases, to have been the strongest. As a proof of this, several places were found where the weak and rotten trees were thrown down by the van of the spout, with the tops of those on the northern side towards the S. W., and the tops of those on the southern side towards the N. W.; while the stronger trees which resisted the first shock were afterwards prostrated by the rear of the spout. And in every case where trees were found lying across each other, which, to a careless observer, might have indicated a whirlwind of confusion, the most perfect regularity was manifested; the strongest trees lying on top, and with their tops pointing inwards and forwards, as mentioned before.

Besides, four different places were found where the tops of all the trees in a circular space, equal in diameter to the breadth of the spout, were thrown inwards towards one common centre. In the middle of one of these stood a large frame house, which had its roof carried

off. The walls of the upper story, both on the north and south side, were cracked; and in one crack was thrust a lady's pocket handkerchief, and in the other a sheet, taken up from a bed in the room, and the cracks closed when they were carried partly through. All the windows in the house were broken, and much of the glass was lying on the outside of the house. The owner of the house is sure all this was done in a second or two of time, and he assured me that the next moment it was as still as death, not enough of air to move the leaves of the trees, which were prostrated all round his house, with their tops against his very door.

In this case the van of the spout appears to have been as strong as the rear, for several out-houses to the east of the dwelling mansion were prostrated, having many of their heaviest materials carried some distance towards the west. Perhaps indeed I was too hasty in drawing the conclusion that the rear of the spout was stronger than the van, from the circumstance that the trees were generally thrown down in the direction of the spout; for if the forces had been *equal*, they might have generally fallen in this direction, from the momentum they would have in this direction in straightening themselves, by their elasticity, at the moment the van passed and the rear came upon them. Notwithstanding, as the wind on that day was from the S. W., this circumstance renders it probable that the rear of the spout was the strongest; for it would appear that the force of the wind, whatever it was, should be added to the rear and subducted from the van.

During the fall of the rain and hail in Staten Island, the wind in the borders of the shower blew in all places from the centre of the shower, very strong in the northern part from the south, variable in the middle, and moderate in the south from the north. And the rumbling noise preceded the fall of the rain at least fifteen minutes at Mussero's ferry, on the very north side of the island. As the time of the shower at this place was certainly, from the evidence, after the spout had disappeared, it seems probable that the spout continued in mid air some time after its disappearance at the surface of the earth.

Was this noise caused by the concussion of the materials, the lighter particles of hail which were then just formed being carried up with great swiftness against the heavier, which at that time might be at their greatest elevation or even beginning to descend; or was it produced by electricity? The height of the spout where it lost itself in the cloud, though it probably rose much higher into the cloud itself, was not very certainly made out.

It is probable, however, from comparing several accounts of the distance at which it was seen, and the angular elevation as near as could be ascertained, that the height was about a mile, or, from the very distinct testimony of Mr. Cole, a little more.

He was standing four and a half miles east of Amboy, beyond which the spout did not reach. He saw a very black column of cloud, about eight times as high as it was broad, rising in the west; lighter clouds on each side of it were "streaming" towards it with great velocity and joining it, but not crossing it. The upper end of

this column was about ten degrees high. The evidence of Mr. Hunt, engineer of the boat Napoleon, is almost exactly similar to Mr. Cole's. He was about seven miles from New Brunswick, and saw the spout before it reached the town. He thinks, however, that the column was only about three times as high as it was broad. After looking at it some minutes, he could plainly see detached pieces of cloud darting inwards and upwards, joining the upper end of the column and losing themselves there, and in five or six minutes more, when the column reached New Brunswick, the materials which had been seen to fly upwards increased in number, and gave the appearance of a volcano; these materials seemed to him to rise three hundred yards. Now as the spout, when first seen by Mr. Hunt, must have been eight or nine miles distant, its height could hardly have been less than a mile.

On this same day three other spouts occurred, about seventeen miles apart, measuring perpendicular to the line of direction of the Brunswick spout. The one next to the Brunswick spout, seventeen miles north, passed through a village in the neighbourhood of Paterson, New Jersey, about three hours after the passage of the spout at Brunswick. It was accompanied by violent hail and rain on the very path of the spout.

On the same day, and afternoon, and night, there was a very great rain in the state of New York, commencing at Schenectady, about three, P. M , with a roaring, of fifteen minutes, like a distant cataract: 2.45 inches of rain fell in Albany, wind N., and much more at Lebanon. And during the whole night of the 19th, there was in the neighbourhood of Amboy a violent S. W. wind and very black clouds coming from the N. E., mingled with a bright silvery light, and most vivid lightning without thunder. The wind below changed about daylight to the N. E., and blew violently very cold for some hours, and then again resumed its old course, S. W., on the afternoon of the 20th.

On this same morning, the 20th, a most violent N. E. gale was experienced at Quebec.

Two conclusions, which promise to be of immense value in meteorology, are clearly deducible from the facts here established.

1. *There was an inward motion of the air in all directions towards the centre of the spout below, and upward motion in the middle.**

2. *The hail was formed by the congelation of drops of rain generated at and over the place where the shingles were taken up.*

Trans. Amer. Philos. Soc.

* The cause of this upward motion in the spout is the great expansion of the air from the evolution of latent caloric, when the vapour in the spout changes to water; the expansion of the air by the liberated caloric being about six times greater than when combined with water in the form of vapour, as has been fully explained in a paper now preparing for insertion in the Transactions of this Society.

Origin of the Mineral Dysodil.

In 1808, Sordier classed this mineral among bituminous substances. It is well known in Sicily, where it is employed as a combustible substance. Ehrenberg, in a paper published last year, demonstrates that this substance, which resembles yellow wax, is formed of the siliceous debris of naviculæ, cemented together by a kind of resin. He shows also that it exists in the collection of Krantz of Berlin, in a lignite of Westerwalde, the colour of which is black, and in which all the microscopic characters of the yellow dysodil of Sicily may be recognised, but with some difficulty, because it is mixed with a considerable quantity of the pollen of pines and other vegetable remnants. Ehrenberg has since found it also in the bituminous foliated coal of Geistinger Busch, near Rott and Siegburg, and also in the foliated lignite of Vogelsberge. He concludes that dysodil is produced by the agglomeration of infusoria, and is obviously a polishing slate, accidentally infiltrated with mineral tar; whilst at Bilin, near Cassel, it is found existing without any mixture of bitumen. Its colour may be yellow, or brown, or black; it occurs generally in extensive beds, and in sufficient quantity to be used for economical purposes.—*Athenæum.* Mining Jour.

Meteorological Observations for September, 1841.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	64	74	29.80	29.80	W.	Moderate.		Clear—do.
	2	64	82	.80	.82	W.	do.	.17	Lightly cloudy—clear—shower.
	3	68	72	.85	.85	S.	do.	.15	Clear—do.—shower.
	4	72	82	.70	.65	W.	do.	.05	Rain—clear.
	5	64	76	.70	.75	N.	Brisk.		Clear—do.
	6	63	76	.90	.94	N.	Moderate.		Clear—do.
	7	66	72	.96	.90	E.	do.		Cloudy—do.
☽	8	63	72	.93	.93	E.	do.		Clear—do.
	9	58	68	.93	.95	E.	do.		Clear—do.
	10	64	76	30.00	30.00	E.	do.		Cloudy—clear.
	11	60	76	29.90	29.90	SE. W.	do.		Cloudy—lightly cloudy.
	12	66	74	.93	.93	NW.	do.		Cloudy—do.
	13	66	71	.90	.94	SE.	do.		Cloudy—do.
	14	56	72	30.00	30.04	W.	Brisk.		Partially cloudy—clear.
⊗	15	56	72	.15	.15	W. E.	Moderate.		Clear—do.
	16	56	69	.17	.00	E.	do.		Cloudy—do.
	17	58	59	.08	.00	E.	do.	.84	Cloudy—rain.
	18	54	72	29.90	29.90	W.	do.		Clear—do.
	19	56	69	30.00	30.04	NE.	do.		Clear—lightly cloudy.
	20	56	69	.00	00	E. S.	do.		Foggy—clear.
	21	62	70	.00	.00	E.	do.		Fog—clear.
☾	22	61	66	29.90	29.80	E.	do.		Cloudy—do.
	23	62	68	.75	.70	E.	do.	.07	Partially cloudy—showery.
	24	69	71	.76	.70	S.	do.	.15	Cloudy—showery.
	25	69	69	.55	.55	SW W.	Brisk.	.03	Cloudy—clear—shower.
	26	54	71	.74	.74	SW.	do.		Clear—do.
	27	54	70	.86	30.00	W. SW.	do.		Clear—do.
	28	62	72	.94	29.83	SE S.	do.		Partially cloudy—cloudy.
	29	67	75	.72	.68	SW.	do.	.32	Showery—flying clouds—rain.
☉	30	54	62	.65	.75	W. NW.	Brisk.		Clear—do.
	Mean	61.47	71.57	29.88	29.88			1.78	

	Thermometer.		Barometer.	
Maximum height during the month,	82 00	on the 2nd and 4th.	30.17	on the 16th.
Minimum " "	54.00	" 18th, 26th, 27th, and 30th.	29.55	" 25th.
Mean	66.35		29.88	

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			…er.							Hygrometer.					
			Minimum	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
	C		29.1	2	1⅔	6⅔	⅔	.	2⅔	....	.	......	....	..	1500
1	Phila														
2	Mont		29.4	2	⅓	10	.	.	⅔	....	.	.....	....	..	1522
3	Buck														
4	Lehig														
5	North														
6	Monr														
7	Pike,														
8	Way		27.1	9⅓	.	6⅓	.	.	.	....	.	......	....	..	1505
9	Susq	3	28.8	⅓	.	6⅔	.	1⅓	6⅔	....	.	......	....	..	1486
10	Luzer	4	28.7	9	⅔	5⅔	.	6⅔	1⅓	....	.	......	....	..	1491
11	Schu														
12	Berks	8	28.9	3	2⅔	8⅓	⅔	.	.	....	.	......	....	..	1480
13	Chest														
14	Delav	6	28.8	1⅓	2⅔	6	1⅓	.	.	50.21	.	......	58.18	..	1519
15	Lanc														
16	York														
17	Leba	2	29.20	10⅔	.	⅓	.	.	8⅔	....	.	......	....	..	1478
18	Daup	8	28.85	3⅓	⅔	5	2	4	.	....	.	......	60.10	..	1479
19	North														
20	Colu														
21	Brad														
22	Tiog														
23	Lyco														
24	Unio														
25	Miffl	9	28.92	1	.	8	.	15	2⅓	....	.	.....	....	..	1484
26	Junia														
27	Perry	5	28.81	4⅔	1⅔	6	.	6⅔	⅓	46.58	1	......	55.07	1	1481
28	Cum	52	28.86	2	1⅓	8⅓	.	⅓	.	50.74	.	......	58.23	..	1526
29	Adar														
30	Fran	51	28.82	21⅔	.	.	.	.	1⅓	....	.	.....	....	..	1508
31	Hun	38	28.94	.	.	.	.	.	.	....	.	......	....	..	1496
32	Cent														
33	Pott	.	....	9⅔	.	⅔	.	.	1⅔	....	.	.....	....	..	1506
34	M'K														
35	Clea	10	27.42	6⅓	⅔	7⅓	⅓	4	1⅔	....	.	.....	....	..	1489
36	Cam	36	28.70	1	.	7⅓	10⅓	.	2⅓	....	.	.. .	....	..	1483
37	Bed	06	27.49	5⅔	2	2	.	8⅔	1⅓	....	.	.....	....	..	1499
38	Som														
39	Indi														
40	Jeffe														
41	War	90	28.45	.	.	22⅔	.	.	4⅔	....	.	.....	....	..	1494
42	Ven														
43	Arm														
44	Wes	14	28.56	2⅔	.	10	.	4⅓	.	....	.	......	....	..	1604
45	Fay														
46	Gree														
47	Wa	49	28.36	1⅓	.	8	1⅔	7⅔	4⅓	....	.	......	....	..	1485
48	Alle	52	28.83	.	.	13	⅓	7⅔	2⅔	....	.	......	....	..	1587
49	Bea	90	28.30	11⅔	.	6	.	.	.	....	.	......	....	..	1488
50	But														
51	Mer	.87	28.20	.	.		.	.	.	....	.	......	....	..	1487
52	Cra														
53	Erie														

METEOROLOGICAL REPORT FOR THE STATE OF PENNSYLVANIA, Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

MAY, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.
1 Philadelphia, .	Philadelphia, .	G. P. Schively, .	57.60	66.48	55.94	84.50	38.00	60.01	2⅓	31.50	49.76	.	29.91	29.89	29.94	30.23	29.10	29.91	2⅓
2 Montgomery, .																			
3 Bucks, .	Newtown, .	L. H. Parsons, .	57.74	63.50	52.80	85.00	33.50	56.35	⅓	29.00	46.02	.	29.93	29.91	29.90	30.20	29.40	29.91	⅓
4 Lehigh,																			
5 Northampton,	Easton,	Charles Elliot, .																	
6 Monroe .	Stroudsburg, .	A. M. Stokes, .																	
7 Pike, .	Milford,	Ralph Bull, .																	
8 Wayne, .	Hone-dale, .	W. Richardson, .																	
9 Susquehanna,	Silver Lake, .	E. Rose, .	47.84	62.90	52.94	93.00	27.00	54.56	.	27.00	45.00	.	27.74	27.76	27.78	28.31	27.14	27.76	.
10 Luzerne, .	Wilkesbarre, .	V. L. Maxwell, .	52.70	62.98	53.70	88.00	33.00	56.46	5	30.00	46.68	3	29.30	29.26	29.27	29.48	28.82	29.28	5⅓
11 Schuylkill, .	Port Carbon .	P. C. Lyceum, .	51.07	70.05	51.37	91.00	31.00	57.50	1⅓	28.00	42.10	.	29.22	29.21	29.25	29.44	28.74	29.23	1⅓
12 Berks, .	Reading, .	C. F. Egelmann,																	
13 Chester, .	West Chester,	Wm. W. Jeffris, .	54.02	65.68	56.33	83.00	32.40	58.68	.	28.50	40.23	.	29.43	29.42	29.45	29.98	28.96	29.43	.
14 Delaware, .	Haverford, .	Haverford School, .																	
15 Lancaster, .	Lancaster, .	Conservatory of Arts,	54.87	67.90	56.58	84.50	34.00	59.78	.	30.00	49.19	.	29.41	29.40	29.42	29.66	28.89	29.41	.
16 York, .																			
17 Lebanon, .																			
18 Dauphin, .	Harrisburg, .	J. Heisely, .	59.26	68.95	65.50	83.00	48.00	64.57	8⅔	44.00	55.59	9	29.68	29.66	29.67	29.92	29.20	29.67	8⅔
19 Northumberland,	Northumberland,	Andrew C. Huston,	54.71	64.13	57.31	83.00	32.00	58.72	.	24.00	44.42	.	29.39	29.33	29.39	29.68	28.85	29.37	.
20 Columbia, .	Danville,	C. H. Frick.																	
21 Bradford, .																			
22 Tioga, .																			
23 Lycoming, .																			
24 Union, .																			
25 Mifflin,																			
26 Juniata, .	Mifflintown, .	J. A. Kinkead, .	47.42	68.35	54.28	87.00	31.00	56.68	2⅓	....	....	.	29.40	29.40	29.41	29.89	28.92	29.40	2
27 Perry, .																			
28 Cumberland, .	Carlisle, .	Prof. W. H. Allen,	55.00	64.20	55.16	83.00	34.00	58.12	⅓	31.00	48.22	.	29.30	29.28	29.31	29.55	28.81	29.30	⅓
29 Adams, .	Gettysburg, .	Prof. M. Jacobs, .	53.58	70.93	55.80	88.50	34.50	60.10	.	30.50	46.16	.	29.37	29.32	29.34	29.52	28.86	29.34	.
30 Franklin, .																			
31 Huntingdon, .	Huntingdon, .	Prof. Jacob Miller,	54.14	68.03	54.80	88.00	33.00	58.99	1⅓	....	....	.	29.29	29.28	29.29	29.51	28.82	29.29	1⅓
32 Centre, .	Bellefonte, .	John Harris, .	55.35	73.26	59.78	88.50	38.00	62.80	15	....	....	.	29.27	20.23	29.25	29.38	28.94	29.25	15
33 Potter, .																			
34 M'Kean, .	Smithport, .	M. R. Atkins, .	44.61	60.51	49.36	82.00	27.00	51.49	1	25.00	39.32	.	....	....	....	....	....	....	.
35 Clearfield, .																			
36 Cambria, .	Ebensburgh, .	Richard Lewis, .	45.90	61.46	48.56	87.00	25.00	51.97	1⅔	24.00	42.00	1	27.85	27.84	27.85	28.10	27.42	27.85	1⅔
37 Bedford, .	Bedford, .	Samuel Brown, .	52.08	65.57	56.33	88.00	32.00	57.99	2⅓	....	....	.	29.16	29.14	29.18	29.36	28.70	29.16	2⅓
38 Somerset, .	Somerset, .	George Mowry, .	49.45	59.69	50.13	80.00	31.00	53.09	2	26.00	43.13	1	27.82	27.83	27.85	28.06	27.49	27.83	2
39 Indiana, .	Indiana, .	Richard White, .																	
40 Jefferson, .	Rose Cottage, .	C. C. Gaskell, .																	
41 Warren, .	Warren, .	J. E. King, .																	
42 Venango, .	Franklin, .	Wm. Connely, .	......	... ..	......	......	....	......	.	....	....	.	28.90	28.90	28.92	29.90	28.45	28.91	7
43 Armstrong, .																			
44 Westmoreland,																			
45 Fayette, .	Uniontown, .	J. P. Weethee, .	52.90	69.02	54.35	91.00	29.50	58.76	.	....	....	.	28.96	28.96	28.96	29.14	28.56	28.96	.
46 Green, .																			
47 Washington, .	Cannonsburg,	Prof. A. H. Campbell,																	
48 Alleghany, .	Pittsburgh, .	J. P. Bakewell, .	55.19	65.40	68.40	85.00	37.00	63.00	7⅓	27.00	47.77	.	29.19	29.18	29.22	29.49	28.36	29.20	2⅓
49 Beaver, .	Beaver, .	James Allison, .	53.00	68.57	55.45	89.00	31.00	59.01	2⅓	26.00	42.42	3	29.32	29.31	29.31	29.52	28.83	29.31	2⅓
50 Butler, .	Butler, .	Jacob Mechling, .	51.52	66.03	58.17	86.00	31.00	58.57	⅓	....	....	.	28.77	28.77	28.77	28.90	28.30	28.77	.
51 Mercer, .	West Greenfield,	S. Campbell,																	
52 Crawford, .	Meadville, .	Henry Shippen, .	48.83	64.93	50.62	87.00	29.50	54.79	⅔	22.00	40.46	.	28.70	28.69	28.69	28.87	28.20	28.69	1
53 Erie, .	Erie, .	Park & Reid, .																	

County.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia	14⅔	13⅓	3	13	....	....	1	3.289	1	⅔	1⅓	.	.	⅓	2⅔	.	1⅔	1	8⅓	⅓	2	1⅓	6⅔	⅔	.	2⅔	....	.	......	....	..	1500
2 Montgomery																																
3 Bucks	13⅓	16⅔	⅔	18	1	.....	..	2.887	.	⅓	1⅓	.	.	⅓	4⅓	1	1⅓	⅔	7⅔	1	2	⅓	10	.	.	⅔	....	.	.....	....	..	1522
4 Lehigh																																
5 Northampton																																
6 Monroe																																
7 Pike																																
8 Wayne																																
9 Susquehanna	13⅓	17⅔	.	7	....	....	1	1.780	5⅔	.	.	.	.	.	1⅓	.	5⅓	.	3	.	9⅓	.	6⅓	.	.	.	....	.	......	....	..	1505
10 Luzerne	6⅔	18⅓	6	8	....	1	1	3.126	1⅔	.	3	.	⅓	.	2⅔	.	⅔	.	7⅔	.	⅓	.	6⅔	.	1⅓	6⅔	....	.	......	....	..	1486
11 Schuylkill	14⅓	15⅓	1⅓	12	....	1	..	3.069	⅓	.	2	1	⅔	.	1⅔	.	⅔	.	1	⅓	9	⅔	5⅔	.	6⅔	1⅓	....	.	......	....	..	1491
12 Berks																																
13 Chester	13⅔	17⅓	.	13	....	....	..	2.135	2⅓	1	1⅓	⅓	⅓	⅓	.	.	1⅔	.	8⅓	⅔	3	2⅔	8⅓	⅔	.	.	....	.	......	....	..	1480
14 Delaware																																
15 Lancaster	15	16	.	13	....	1	..	2.360	2⅔	1	2	1	.	.	1⅔	3	2⅓	2⅔	3	⅓	1⅓	2⅔	6	1⅓	.	.	50.21	.	......	58.18	..	1519
16 York																																
17 Lebanon																																
18 Dauphin	.	.	.	....	....	....	..	......	⅓	.	.	.	1⅓	.	1⅔	.	4⅓	.	3⅔	.	10⅔	.	⅓	.	.	8⅔	....	.	......	....	..	1478
19 Northumberland	7⅓	23⅔	.	11	....	....	3	4.283	3⅓	.	2⅔	⅔	⅓	.	2⅔	⅔	3⅔	.	2	.	3⅓	⅔	5	2	4	.	....	.	......	60.10	..	1479
20 Columbia																																
21 Bradford																																
22 Tioga																																
23 Lycoming																																
24 Union																																
25 Mifflin																																
26 Juniata	12	16	3	6	2	....	1	3.160	.	.	1	.	⅓	.	2	.	.	.	1⅓	.	1	.	8	.	15	2⅓	....	.	......	....	..	1484
27 Perry																																
28 Cumberland	11⅓	19⅓	⅓	11	....	....	..	3.431	2	⅓	1	.	⅔	.	2⅓	⅔	2	⅓	2	⅓	4⅔	1⅔	6	.	6⅔	⅓	46.58	1	......	55.07	1	1481
29 Adams	13	18	.	10	...	....	1	3.403	⅓	1	3⅔	.	.	.	2⅔	1⅔	3	⅔	4⅓	⅔	2	1⅓	8⅓	.	⅓	.	50.74	.	......	58.23	..	1526
30 Franklin																																
31 Huntingdon	18	13	.	7	1	....	1	4.300	.	.	.	.	8	.	.	.	.	.	.	.	21⅔	.	.	.	.	1⅓	....	.	......	....	..	1508
32 Centre	.	.	.	....	....	....	..	.. ...	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	......	....	..	1496
33 Potter																																
34 M'Kean	15⅔	14⅓	1	8	2	....	2	1.323	⅔	.	⅔	.	⅔	.	3⅓	.	6⅓	.	7⅓	.	9⅔	.	⅔	.	.	1⅔	....	.	......	....	..	1506
35 Clearfield																																
36 Cambria	9	19⅔	2⅓	8	1	....	5	5.784	⅔	.	⅓	.	⅔	.	2⅓	.	2⅓	.	4	⅓	6⅓	⅔	7⅓	⅓	4	1⅔	....	.	......	...	..	1489
37 Bedford	12⅔	16	2⅓	....	....	....	..	......	.	.	.	⅔	.	2⅓	2	.	⅓	1⅓	3	.	1	.	7⅓	10⅓	.	2⅓	....	.	.. .	....	..	1483
38 Somerset	9	20	2	8	2	....	2	3.833	⅓	.	1	⅔	⅓	.	2	⅔	⅔	1	4⅓	⅓	5⅔	2	2	.	8⅔	1⅓	....	.	......	....	..	1499
39 Indiana																																
40 Jefferson																																
41 Warren																																
42 Venango	.	.	.	....	....	....	..	......	.	.	.	.	.	.	3⅔	.	.	.	.	.	.	.	22⅔	.	.	4⅔	....	.	......	....	..	1494
43 Armstrong																																
44 Westmoreland																																
45 Fayette	21	10	.	5	....	....	..	......	1⅓	.	2⅓	.	.	.	2⅓	.	.	.	8	.	2⅔	.	10	.	4⅓	.	....	.	......	....	..	1604
46 Green																																
47 Washington																																
48 Alleghany	14	15	2	7	....	....	..	3.014	.	.	.	.	1	⅔	4⅓	⅔	.	.	⅔	⅔	1⅓	.	8	1⅔	7⅔	4⅓	....	.	......	....	..	1485
49 Beaver	14⅔	13⅔	2⅔	6	....	....	..	1.847	.	.	1	⅓	⅓	.	2	.	.	.	2⅓	⅓	.	.	13	⅓	7⅔	2⅔	....	.	......	....	..	1587
50 Butler	.	.	.	5	3	....	1	2.432	.	.	2	.	4	.	⅔	.	.	⅓	6⅓	.	11⅔	.	6	.	.	.	....	.	......	....	..	1488
51 Mercer																																
52 Crawford	8	11⅓	11⅔	....	....	....	..	......	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	....	.	......	....	..	1487
53 Erie																																

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DECEMBER, 1841.

Civil Engineering.

Description of the Bear Trap Sluice Gates of the Lehigh Descending Navigation. By Ellwood Morris, *Civil Engineer.*

The public are indebted to the inventive genius of Josiah White, Esq., President of the Lehigh Coal and Navigation Company, for the admirable hydrostatic contrivance which has received the singular name of *Bear Trap.**

These sluice gatés were devised under the following circumstances: in the year 1818, Messrs. White, Hauto, Hazard, and others, associated themselves under the style of the "*Lehigh Navigation Company*," for the purpose of improving the Lehigh river by means of wing-dams, &c., so as to form a descending navigation suitable for the transportation of coal from the Anthracite mines, near Mauch Chunk, to the city of Philadelphia.

This work was commenced upon the 10th of August, 1818, as appears by the "History of the Lehigh Coal and Navigation Company, published by order of the board of managers in 1840," and did not originally contemplate the use of sluice gates as a primary expedient; the residents upon the margin of the Lehigh river having pointed out "a certain mark in a rock at the Lausanne landing," as the low-water level of the stream, Messrs. White & Co. were induced to

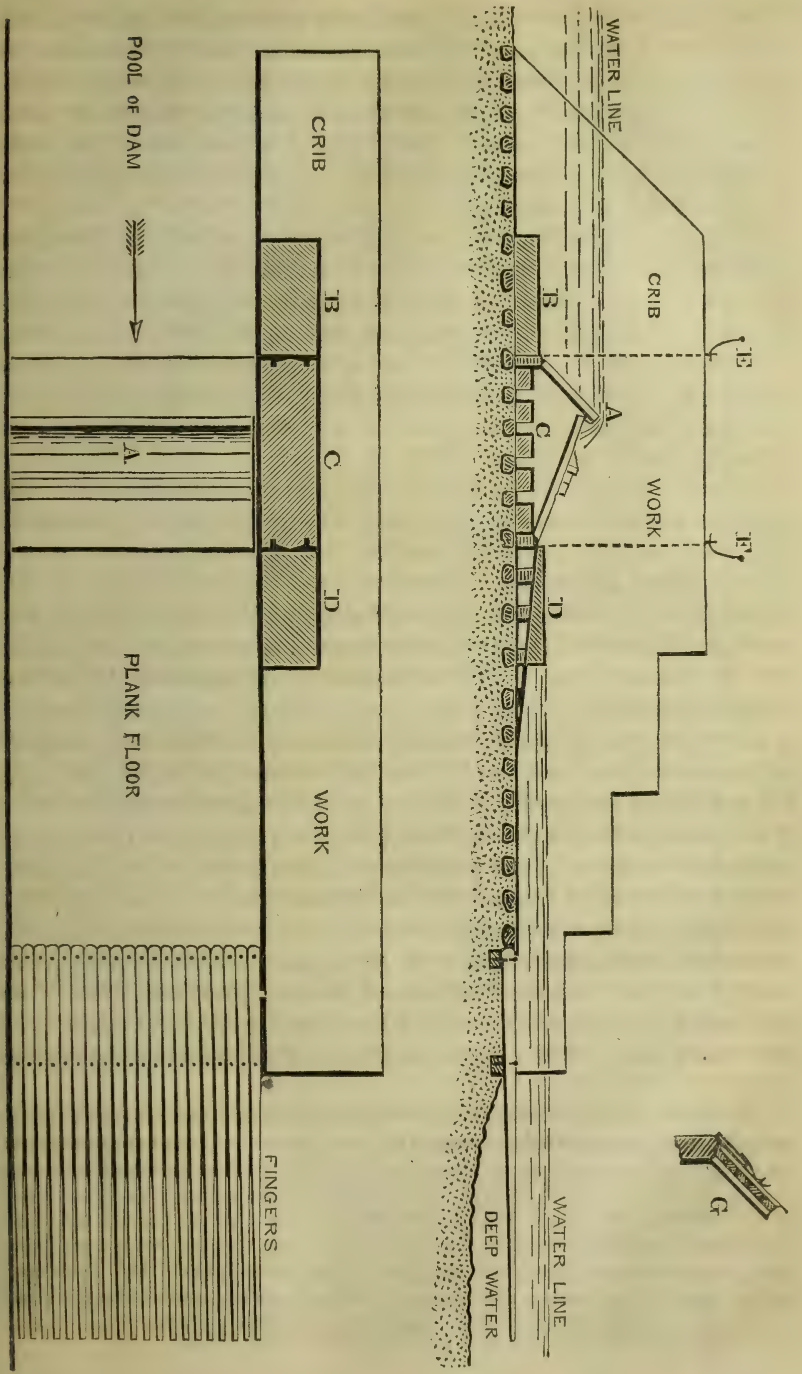
* The writer is indebted to Josiah White and Erskine Hazard, Esqs., for the opportunity of examining the drawings in the office of the Lehigh Company, and for the personal explanations which have enabled him to draw up, for the Journal of the Franklin Institute, the present account of the Bear Trap Sluice Gate.

believe that there would always be a sufficiency of water for their purposes, if it were "confined by wing-dams in its passage over the ripples, or shoals, from pool to pool," and under this impression the work was begun; but in the autumn of 1818 "the water in the river fell by an unparalleled drought, as was believed, fully twelve inches below the mark which has been mentioned as shown by the inhabitants to be the lowest point to which the river ever sunk. Here was a difficulty totally unanticipated, *and one which required a very essential alteration in the plan.* Nature did not furnish enough water by the regular flow of the river, to keep the channels at the proper depth, owing to the very great fall in the river and the consequent rapidity of its motion. It became necessary to accumulate water *by artificial means,* and to let it off at stated periods, and let the boats pass down with the long wave thus formed, which filled up the channels. This was effected by constructing dams in the neighbourhood of Mauch Chunk, in which were placed sluice gates of a peculiar construction, *invented for the purpose* by Josiah White, one of the managers, by means of which the water could be retained in the pool above, until required for use. When the dam became full, and the water had run over it long enough for the river below the dam to acquire the depth of the ordinary flow of the river, the sluice gates were let down, and the boats, which were lying in the pools above, passed down with the artificial flood."

It was to meet the exigency created by the discovery above mentioned, that Mr. White contrived the beautiful sluice gate, which we are about to describe, and upon the successful operation of which, the whole enterprise very much depended.

At that day the scene of the company's operations was almost a perfect wilderness, and the carpenters having been set at work to frame a sluice gate for trial, it became an object of great curiosity to the settlers; who being far more familiar with the implements used in the chase and capture of the beasts of the forest, than with the hydraulic works of a flash navigation, either in jest, or from some fancied resemblance of the sluice gate to a *Bear Trap,* quickly gave to it this cognomen, which it ever since has borne.

The *Bear Trap Sluice Gate,* which is exhibited in plan and section in the annexed diagrams, consists of two leaves or shutters, reclining against each other so as to present a triangular vertical section, and contain beneath them a space capable of being filled with water from the superior level and emptied thereof at will; the contained angle at the vertex when the gates are up being rather more than 100°, in order that the leaves may slide easily, one over the other, which they evidently would not do if the vertical angle of the uplifted gate were


POOL OF DAM
CRIB
B
A
C
D
PLANK FLOOR
WORK
FINGERS
WATER LINE
CRIB
B
A
C
WORK
E
F
D
G
WATER LINE
DEEP WATER

either a right or an acute angle; this sluice gate is raised and depressed by hydrostatic pressure, applied and removed upon the principle of that well known philosophical instrument called the Hydrostatic Bellows; in its usual form, as applied upon the Lehigh, *it will not work in dead water*, but requires the action of a head more than sufficient to overcome the weight and friction of the gates, to enable it to be manœuvred with facility.*

By an inspection of the diagrams it will be perceived that the leaves of the gate are hinged horizontally with hollow quoin joints, at some distance above the floor; the hinge of the upper leaf being higher than that of the lower, by something more than its thickness, so that even when the gate is down there is a vacant space into which the aperture opens from the well C, because the height of the hinge of the lower leaf is fixed at about the same level as the tops of the openings communicating with the well.

Catch blocks on the underside of the upper leaf determine the height to which the rise of the gate is limited; the well C is constantly in communication with the vacancy beneath the gate; the water chamber B, is constantly open to the water from the upper level, whilst that of the lower level flows freely into the chamber D; it will be observed that both these chambers communicate by suitable wickets with the well C; now it will be evident from inspection that if the wickets F, between C and D are shut, whilst the wickets E between C and B are opened, the water from the upper level will enter beneath the leaves with the *upward* hydrostatic pressure due to the head, and the gate will consequently rise; now on the other hand if the wickets E are closed, whilst those at F are opened, the *downward and lateral* hydrostatic pressure of the water in the upper level, acting then upon the top surface of the upper leaf, will force down the gate; and thus by simply putting the vacancy beneath the leaves of the sluice gate, in communication *separately* with the upper and lower levels *alternately*, the gate is elevated, depressed, or arrested at any stage of its movement, by hydrostatic pressure alone; the only manual labour or attention needed for the highest and widest gates, being that which

* Mr. English, formerly a contractor upon some of the works of the Lehigh navigation, having for many years observed the action of the Bear Trap Sluice Gates, has conceived the idea of rendering them applicable as the upper gates of *Lift Locks*, by placing a large air vessel under the lower leaf, which by its buoyancy enables the gates to rise in dead water: and he has exhibited at the Franklin Institute a working model of a lock having the Bear Trap Gates with his attached air vessel applied as *upper gates;* and, though liable to some objections there is reason to believe that for the upper, if not for both, gates of *Lift Locks* only, they will prove to be a valuable improvement, though it is evident that the same object may be attained; by the application of counter weights, but not perhaps as well as by an air vessel.

is requisite to manœuvre the wickets E or F, a duty for which a mere boy would be physically competent.

The sluice gates used upon the Lehigh descending navigation, as there is no necessity of making them perfectly water tight, are allowed a play on each side of half an inch or more, which effectually prevents lateral friction; they are generally twenty-four feet wide, formed by spiking together three successive layers of thick plank, and the lower leaf is strengthened by bolting upon its back a few heavy beams, (as may be seen in the sketch annexed,) which rest their extremities against suitable stops when the gate is up.

Where the water, violently descending the sluice, leaves the platform, it usually excavates the bed of the stream and forms deep water, the sudden entrance into which, of boats shooting down the sluice, would prove very injurious to, or even destroy, them, if it were not for the ingenious device called *fingers;* these consist of the trunks of trees placed side by side, and bolted to heavy subsills, with their butts up-stream, the tops freely projecting over the lower sill some twenty feet or more; they receive in part the shock of the boat in its plunge into the deep water, and by their elasticity ease off its momentum so that it glides down with the swift stream uninjured; this dexterous mode of avoiding concussion, is found in practice fully to answer the end for which it was designed.

For the purpose of guarding the horizontal hinges of the leaves of the sluice gates against obstruction from the deposition of gravel, a glove of plank is ingeniously secured across the hinge by a curved spring, as shown at G, and in contact with this plank glove, the leaf revolves upon its hinges, without the possibility of being impaired in its action by the lodgment of hard substances.

From the above description and the annexed sketches, which are designed more to develope *the principle* of the sluice gate, than to display all the details of its construction, it is hoped that the plan and mode of action of the *Bear Trap Sluice* may be gathered without further explanation, and we will now proceed to make a few remarks upon the great usefulness of this invention.

Utility of the Bear Trap Sluice.

This skilfully devised hydraulic machine, continued in use upon the lower Lehigh—giving perfect satisfaction in practice—from the year 1821 until 1829, when the descending navigation upon the main part of the river, was abandoned for an improvement which admitted of transit in both directions: though a section upon the former plan, with its Bear Trap Sluices, still forms the navigation for the lumber trade between Whitehaven and Stoddartsville, a distance of twelve and one

fourth miles, in which by wing-dams, channels, and sluices, a fall of three hundred and thirty-six feet is overcome.

The causes which led to the substitution of a slackwater, for a flash navigation, and the difficulties met and surmounted by the ingenious and energetic individuals, who directed the works of the Lehigh company, are so interesting that we will make a digression to quote a few more passages from the company's published "History."*

"The boats used upon the Lehigh descending navigation consisted of square boxes, or arks, from sixteen to eighteen feet wide, and twenty to twenty-five feet long. At first two of these were joined together by hinges, to allow them to bend up and down in passing the dams and sluices, and as the men became accustomed to the work, and the channels were strengthened and improved as experience dictated, the number of sections in each boat was increased, till at last their whole length reached one hundred and eighty feet. They were steered with long oars like a raft. Machinery was devised for jointing and putting together the planks of which these boats were made, and the hands became so expert that *five men would put one of the sections together and launch it in forty-five minutes.* Boats of this description were used on the Lehigh till the end of the year 1831, when the Delaware division of the Pennsylvania Canal was partially finished. In the last year, forty thousand nine hundred and sixty-six tons were sent down, which required so many boats to be built, that, if they had all been joined in one length, they would have extended more than *thirteen miles.* These boats made but one trip, and were then broken up in the city, and the planks sold for lumber, the spikes, hinges, and other iron work being returned to Mauch Chunk by land, a distance of eighty miles.

"The great consumption of lumber for the boats very soon made it evident that the coal business could not be carried on, even on a small scale, without a communication by water with the pine forests, about sixteen miles above Mauch Chunk, on the upper section of the Lehigh. To obtain this was very difficult. The river in that distance, had a fall of about three hundred feet, over a very rough, rocky bed, with

* In the published history from which we quote, the opinion is advanced, that "the descending navigation by artificial freshets on the Lehigh, is the first on record as a permanent thing."

This, however, is a mistake, for the system of rendering shallow streams navigable by the mode called *Flashing,* which is "to create an artificial flood for a time by penning up the water in the river itself," and then opening the sluice or flood-gates, when the boats are passing, is supposed to have been invented by the Egyptians after the time of Alexander, and was found in use in the hydraulic works of the interior of China, when that empire was visited by the first English embassy.

See New Edinburgh Encyclop. Art. Nav. Inland.

shores so forbidding that in only two places above Lausanne had horses been got down to the river. To improve the navigation it became necessary to commence operations at the upper end, and to cart all the tools and provisions by a circuitous and rough road through the wilderness, and then build a boat for each load to be sent down to the place where the hands were at work, by the channels which they had previously prepared. Before these channels were effected, an attempt was made to send down planks, singly, from the pine swamps, but they became bruised and broken by the rocks before they reached Mauch Chunk. Single saw-logs were then tried, and men sent down to clear them from the rocks as they became fast. But it frequently happened that when they got near Mauch Chunk, a sudden rise would sweep them off, and they were lost.

"It became evident that the business on the Lehigh could not be extended as fast as the demand for coal increased, while it was necessary to build a new boat for each load of coal; besides the forests were now beginning to feel the waste of timber, (more than 400 acres a year being cut off,) and showed plainly enough that they would soon disappear, in consequence of the increased demand upon them.

"Under all these circumstances, it was concluded that the time had arrived for changing the navigation of the Lehigh into a slackwater navigation. The acting managers, who resided at Mauch Chunk, formed a plan for a steamboat navigation with locks one hundred and thirty feet long and thirty feet wide, which would accommodate a steamboat carrying one hundred and fifty tons of coal. These locks were of a peculiar construction, adapted to river navigation. The gates operated upon the same principle with the sluice gates in the dams for making artificial freshets, and were raised or let down by the application or removal of a hydrostatic pressure below them. The first mile below Mauch Chunk was arranged for this kind of navigation. *The locks proved to be perfectly effective and could be filled or emptied, notwithstanding their magnitude, in three minutes, or about half the time of an ordinary lock.*"

One of the writer's objects in making the above lengthy extract, was to enable the reader to trace the causes which led to the abandonment of the flash navigation on the Lehigh, and to see that it arose from no defect in the sluice gates or other works at first erected.

It must be evident to every one that *the Bear Trap Sluice Gates*, finding as they do their operating power in the hydrostatic pressure consequent upon the difference of level which they overcome, are capable of application to almost any width of opening; and that a gate of one hundred feet or more in length could be manœuvred as readily as one of twenty-four feet, the only additional labour requisite being that of opening and closing a few more wickets.

In the descending navigation of the Lehigh, a case occurred where a fall of sixteen feet in about three hundred was overcome by one of the Bear Trap Sluices, though it was found necessary here to bolt a series of beams upon the platform, transversely across the opening, so as to moderate the velocity of the descending volume of water, by increasing its friction upon the bottom of the passage.

For the gates of the locks of a steamboat, or other large navigation,* —for the gates of a dry dock by using the air vessel in raising; and in lowering them, a pump to extract the water from the space beneath —for all sluices where the sudden discharge of large bodies of water is required—for the waste-weirs and stop-gates of canals—and for other similar purposes, *the Bear Trap Sluice Gate* leaves nothing more to be desired, and is certainly far superior to any other contrivance for effecting the same purposes, which the writer has ever seen in practice or found described in the professional writings to which he has had access.

With gates of this sort of one hundred feet opening, having suitably prolonged chamber walls, and placed in low dams of four or five feet high, it would probably be easy to maintain throughout the year a steamboat navigation upon the upper waters of the Ohio, as the powerful steamers in use upon the western rivers, would find but little difficulty in stemming the current through such wide openings in dams of small height upon a low river, whilst in high floods they could pass up over the dams themselves, as they now do at such times over the falls at Louisville, Kentucky.

Philadelphia, October 15*th*, 1841.

Railways in Germany.—Railway between the Moldau and Danube.

CONTINUED FROM PAGE 246.

The railway from Budweis, in Bohemia, to Lintz, in Upper Austria, connecting the Moldau with the Danube, and the North sea with the Black sea, claims the merit of having been the first constructed and put into operation on the continent of Europe, for the transportation of passengers and freight. It was commenced when railways had made but little progress in England, and were known in Germany only in some of the deep mines of Saxony; and although intended only for horse power, and constructed accordingly, though in many respects behind the modern improvements of this kind, a short notice of it may perhaps be welcome to those who take an interest in the history of railways.

The project for this railway originated in the proceedings of the commissioners from the ten Elbe-states, who held a convention at

* When used for lock, or dock gates, proper stops should be placed to receive the leaves of the gate, both when up and when down, so as to avoid any loss of water in either of these positions, whilst lateral play enough is allowed to enable an easy motion in both directions.

Dresden in 1819, with the object of regulating the free navigation upon the river Elbe. Before parting they applied to the Austrian Government with the request to improve the navigation of the river Moldau to the town of Budweis, and to construct, from thence to the Danube, a canal, in order to connect the waters of the North sea with those of the Black sea. The late Chevalier de Gerstner, then professor of mathematics in Vienna, immediately put himself at the head of the undertaking, made a survey of the country, and proceeded to England, there to consult about the best plan of crossing by a railway the ridge of mountains separating the valleys of the Moldau and Danube, and which at the point of crossing is 1000 feet above the level of water in the one, and 1500 feet in the other river. Contrary to the opinion of some eminent English engineers, he adopted the plan of reaching the summit by a gradual ascent, and not to resort to inclined planes requiring stationary power. Returned from England in 1822, he proceeded to make very minute surveys, and on the 7th of September, 1824, received for his own person a privilege from his late Majesty, Francis I, for the construction and use of a railway between the Moldau and the Danube. In March, 1825, he formed a company of stockholders in Vienna, and constructed and finished the first thirty-nine miles, from Budweis to the summit, up to the end of 1828. The principles adopted in the construction of this part of the road were not to introduce any steeper gradients than forty-four feet per mile, nor any sharper curves than 622 feet radius; finally, never to lose again any ascended height. Difficulties having afterwards arisen with the Railway Company, in consequence of the excess of expenditure over the estimate, the Chevalier de Gerstner resigned his office as chief engineer, and the railway was, in the subsequent years, finished under the superintendence of his assistant, Mr. Shoenerer. The latter half of the road, however, which was put into operation on the 1st of August, 1832, has only the merit of having been executed in the cheapest possible manner; the principles of construction so judiciously adopted by the Chevalier de Gerstner were entirely abandoned; the railway here frequently loses ascended heights, has a maximum rise of 115 feet per mile, and curves of sixty feet radius, and in fact offers little advantage over a good turnpike road.

The total length of the railway, beginning in the centre of the town of Budweis, and terminating at Urfar, a suburb of Lintz on the Danube, is eighty miles; it was commenced in 1825, and finished in 1832, at an aggregate cost of £165,430 sterling, being only £2,068 per mile, with a single track, including all the necessary buildings, wagons, carriages, &c., &c. To cover these expenses, there were issued:—

3,783 shares, at £20, - - - -	£75,660
9,000 do. do. sold at £5 only, - -	45,000
And there was made a loan at five per cent. -	40,000
	£160,660

400 shares at £20, were given as a premium for this loan, and 1,817 shares at £20, were lately issued and sold at £11, to pay some

temporary debts, and for other purposes. 15,000 shares at £20, or £300,000, therefore, are now the capital stock of the company. Of the loan of £40,000, £1,200 are paid back annually, and there remain at present due only £28,000. The circumstance of the amount of capital stock and loan being £328,000, or just twice as large as the actual cost of the railway, must of course operate injuriously upon its dividends.

The railway from Budweis to Lintz has a single track of 43½ inches in width, measured between the rails; it passes through a very wild and broken country, frequently along steep side hills, on the edge of deep ravines; crossing from one valley to the other, winding its course in a thousand curves to the high summit, and then descending again in a still more circuitous route into the deep valley of the Danube. About one-half of the road is in Bohemia, the other half in Upper Austria. There are in the whole line, 965 culverts and bridges, 2,860,000 cubic yards of excavations and embankments, 376,000 cubic yards of dry walls, and 67.000 cubic yards of masonry laid in mortar. The dry walls were at first designed to support the superstructure of the railway, and erected simultaneously with the embankments to the requisite height; afterwards they were omitted, and the superstructure laid upon the surface of the earth, or gravel. It consists in cross ties of six feet in length, and six inches in diameter, flatted only on the lower side, and notched in to receive the longitudinal or bearing timbers of six by seven inches. The cross ties are laid at a distance of three feet from each other, and the longitudinal timbers are eighteen feet in length. Upon the latter, iron plate rails of nine feet in length, and two and a half by one-half inch, are fastened with square spikes of five inches in length. The timber is now delivered to the railway, ready for laying down, at one penny per foot run for the longitudinal stilts, and at five-sixths of a penny for the cross ties. The iron plate rails are got from the iron works in Bohemia, or Styria, at £13 10s. per ton; the spikes for fastening the rails at £1 7s. per cwt.

The railway is used principally for the transportation of salt and merchandise, which is carried on in summer and winter without interruption. During the better seasons passengers are also conveyed over the road, but their number is very small. Horse power is exclusively employed; a wagon weighing one ton is generally loaded with two and a quarter tons of goods, and according to the rate of ascent on different parts of the railway, one horse will draw two such loaded cars; three horses five wagons, one horse one wagon, and finally, two horses one wagon. The gross load drawn by one horse therefore varies from one and five-eighth tons to six and a half tons; the average load for the whole line being three and a quarter tons, allowing a net load of two and a quarter tons. The whole line is divided into six divisions, and there are, therefore, besides the principal stations at both ends, five intermediate ones, where the horses are changed. Three days are allowed for a freight train to pass over the whole line; it leaves the station in the morning, arrives at the next at noon, where the horses are changed, and then proceeds to the second

in the afternoon; the same horses pass from one station to the other and back the same day, and perform in this way twenty-seven miles regularly. The goods are received and forwarded by the Railway Company, who charge—

	Per ton, from Budweis to Lintz.
For grain and coal, - -	7.2s. or 1.08d. per mile.
Other articles, - - -	9.6s. or 1.44d. per mile.
	Per ton, from Lintz to Budweis.
For grain and coal, - -	14.4s. or 2.16d. per mile.
Other articles, - - -	18s. or 2.7d. per mile.

The company keep the railway and buildings in good order, furnish the wagons and all men necessary for repairing the same, loading, and unloading, &c.; the motive power is let to a contractor, who finds the horses, drivers, and grooms, and receives so much per cwt. carried over the whole distance between Budweis and Lintz. The amount is in some measure proportionate to the price of oats; it was fixed last year at 6s. per ton for the whole distance, (eighty miles) or at 0.9d per ton per mile, when the price of oats was 1s. 4d. per bushel, and 2d. more were paid per ton for every penny the bushel of oats increased in price. In August, the price of oats was 1s. 8½d., and the contractor got, therefore, 6s. 9d. per ton for eighty miles, or one penny per ton per mile. The charges for motive power were always determined for one whole month, the average market price of oats for the month past having served as a basis for the calculation. The public houses attached to the stables at the five intermediate stations were erected by the company, but are left gratuitously to the contractor of motive power for the accommodation of his men.

Passengers are carried daily over the railway, (except in winter,) in two different classes of carriages; the charge for a seat in a first class carriage is 6s., in the second class, 4s., being at the rate of only 0.9d. and 0.6d. per mile. Two carriages containing each six seats inside, and as many outside, start daily in the morning from each end of the line, drawn by two, three, or four horses, as the rate of ascent requires, the horses are changed five times. Half-way, near the summit, the carriages coming in opposite directions meet, and here an hour is allowed for dinner; the whole distance is generally performed in fourteen hours, including all stoppages, and the speed is from six to six and a half miles per hour. Horses and drivers are furnished by the same individual who contracted for the transportation of freight, and he receives one-half of the revenue from passengers, after deducting the salaries of conductor, and some other incidental expenses.

The following statement exhibits the traffic and travel, and the net income of this railway from the year 1833 to 1839 inclusive.

Year.	Quantity of salt transported.	Quantity of merch. transported.	Total quantity.	Wood.	Passengers carried.	Total net income.
	Cwt.	Cwt.	Cwt.	Fathoms (120 c. ft.)		£ s.
1833			331,609	2,733		6,805 14
1834			450,444	2,654	2,379	7,582 18
1835	320,212	194,040	514,252	1,862½	3,887	9,037 11
1836	352,671	190,431	543,102	2,124	3,948	9,151 2
1837	324,251	168,842	493,093	2,538	3,887	8,129 18
1838	345,647	234,813	580,460	2,078	5,454	9,773 15
1839	392,388	301,737	694,125	3,721	10,479	9,177 7

It appears, therefore, that there was a constant increase in the traffic; taking the average for the whole seven years, we have per year, 25,765 tons of goods, and 2,530 fathoms of burning wood; calculating the latter at one and a half tons per fathom, we find the annual transportation equal to 30,000 tons of goods, and 5,000 passengers; in the year 1839, there were transported 40,287 tons of goods, and 10,479 passengers.

The average net income per year amounted to £8,522 12s.; if the same be compared with the cost of the road, viz.: £165,430, it shows that the railway, from the commencement of its operations, has yielded a profit of over five per cent. on its cost; notwithstanding its most disadvantageous line and profile, the necessity of employing horse power instead of steam power, which would be much cheaper, the comparatively small traffic, and the low charges for freight and passage; a result which must be regarded as highly favourable, and encouraging for the undertaking of similar works in parts of the country less wild and mountainous, and more populous and productive.

Railway from Lintz to Gmunden, in Upper Austria.

When the first railway in Austria, from Budweis to Lintz, had been completed, in spite of the many embarrassments and difficulties which attended its progress, the company found it their interest to extend the same from Lintz to Gmunden, on the Traun-lake, which they were permitted to do under their original charter. This new railway was commenced in 1832, finished partly in 1835, and opened in its whole length in May, 1836; its principal object is to furnish the means of cheap transportation for the immense quantity of salt, which is manufactured in the vicinity of the Traun-lake, and exported principally to Lower Austria and Bohemia; passing through a very populous section of country, it also accommodates a very great local travel, and

is besides frequented by those who visit from the north, the celebrated watering place of Ishel, or the Alps in Salzburg and Tyrol.

The line of the Lintz and Gmunden Railway commences on the right bank of the Danube at Lintz, passes through several streets level with the pavement, to the outskirts of the city, in the direction of the river Traun, the course of which it then follows up to the foot of the lake of that name. The whole length is 42¼ miles, a small branch of one and a half miles leads from the main line, near Lintz to Zitzlau on the Danube, where the goods destined for Lower Austria are transhipped directly into the boats. In general, the country through which this railway passes is more favourable, the line therefore pretty direct, and the curves are gentle. The maximum rise is fifty-three feet per mile, with the exception of a short part near Gmunden, where a rise of 240 feet per mile has been adopted. The plan of construction is the same as that of the railway from Budweis to Lintz, a single track, with turnouts; the clear width three feet seven and a half inches. The total amount expended for the construction of the road, buildings, fixtures, &c., was £71,970; the cost per mile was therefore only £1,645. The funds were raised by private loans; certificates of stock, to the amount of £65,000, bearing five per cent. interest, and redeemable after ten years, were issued by the company; and in order to get subscriptions for the same, the first subscribers were promised to receive such profits as would remain after the payment of the interest, and all the current expenses. The holders of the scrips in this manner received, besides their interest, in 1836, £1,036; in 1837, £1,917; and in 1838, £2,072. For these profits they were for the future compensated by 1036 shares of the original stock of the Budweis and Lintz Railway, so that the whole profit of both railways is now regularly divided amongst the shareholders, after the interest on the loans has been paid. In 1846, the capital borrowed, of £65,000, may be paid back at once, or at the option of the company, in twenty annuities from thence, with the interest at five per cent. on the amounts due.

The contractor of motive power on this railway receives 2s. 6d. per ton for the whole distance, (42¼ miles,) or 0.7d. per ton per mile, when the price of oats is 1s. 6d. per bushel, and 1d. more per ton for every 1d. the price per bushel is greater than 1s. 6d. In August, 1840, when the price of oats was 1s. 11d., the contractor received, for furnishing the motive power, 2s. 11d. per ton for the whole distance, or five-sixths of a penny per ton per mile. The same contractor also receives 7⅕d. per passenger carried over the whole line, which is only at the rate of 0.17d. per passenger per mile. The company charges, per ton of goods of every description, 7s. 9½d. for the whole distance, or 2.22d. per ton per mile.

For passengers.—1st class, 2s. 6d., or 0.71d. per mile.
Do. 2nd class, 1s. 7d., or 0.46d. per mile.

Notwithstanding these low fares, the income from this railway has, since the commencement of its operations, been very considerable, as

may be seen from the following statement of the annual traffic and net income for the years 1836 to 1839, inclusive:—

Year.	Salt.	Merchandize, &c.	Total quantity.	No. of Passengers.	Net income.
Cwt.	Cwt.	Cwt.	Cwt.		£ s.
1836	464,492	143,174	607,666	74,759	4,262 13
1837	569,232	144,809	714,041	77,905	5,236
1838	601,606	157,687	759,293	90,353	5,373 16
1839	652,218	156,106	808,324	103,713	6,004 13

At an average there were carried upon the road annually—

Salt, - - -	28,594 tons.
Other articles, - -	7,522 "
Total,	36,116 tons of goods, and 86,682 passengers.

The net income amounted, per year, to £5,219 5s., equal to seven and a quarter per cent. on the cost of the railway of £72,000.

Both railways are managed by the same Board of Directors; the technical department is superintended by a road commissioner, who receives a salary of £120 per year, besides £30 for traveling expenses, &c. The railway track is kept in order by workmen stationed along the line. There were fifty-two small houses built for them at a distance of one and three quarters to two and a quarter miles from each other; each is inhabited by a married man, who works with his wife, and receives 20s. per month, and some of the old timber for fuel. In each division of twelve to fourteen miles, a way-master is appointed, who superintends the workmen, and has a salary of £3 per month. About 600 wagons, and forty-five passenger carriages, are upon both railways; their repairs are conducted by a foreman, assisted by a carriage-maker, two harness-makers, and a suitable number of blacksmiths. The principal work-shops of the company are at Urfar and at Lest.

The railways here described have acquired additional importance since the opening of steam navigation upon the Danube, between Lintz and Vienna. The distance between the two cities is 144 miles. The iron steamboat Sophia, sixty horse power, drawing three feet water, performs the trip *down* to Vienna in nine and a half to ten hours, including stoppages. The running time is about nine hours, and the average speed, therefore, sixteen miles per hour; but it must be remarked that the river has a current of near five miles per hour, and that it requires from thirty to thirty-six hours for the same steamboat to run *up* the river to Lintz. The coal used in the steamboats upon the Danube is brought from Pilsen, in Bohemia, eighty-five miles upon a turnpike road to Budweis, and other eighty miles over the railway to Lintz. The transportation over the first costs 18s. per

ton; over the latter, only $7\frac{1}{5}$s., which shows clearly the advantage of a railway over a turnpike road, even in a mountainous country. At Lintz, the coal is sold at £1 16s. per ton.

TO BE CONTINUED.

Practical & Theoretical Mechanics & Chemistry.

Memoir on the Preservation of Timber. By M. A. Boucherie, M. D.

[CONTINUED FROM PAGE 355.]

Of the Play of Timber, and the means of remedying it.

Wood, when worked up, however dry it may be, expands and contracts incessantly under atmospheric influences; from this result cracks, which are the mortification of constructors, and which become serious, when the wood employed was not sufficiently seasoned.

This seasoning, which requires a long time for timbers of ordinary dimensions, is still more slow in large pieces. The consequence is, that in proportion to the mass of wood annually cut, an enormous capital thus remains inactive. These inconveniences have for a long time employed the attention of those who cut timber, and have been a subject of much study to the engineers of the Marine department.

A more rapid seasoning has been sought for, and obtained, by squaring the wood the moment that it is cut in the forests; but the loss of time is still considerable, notwithstanding their recourse to careful piling, under sheds, and upon a carefully chosen soil.

The previous immersion of the timbers in fresh and salt water has also been tried without more success.

As to the seasoning obtained by means of furnaces and drying ovens, besides the onerous expense which they require, it is admitted that wood thus dried, absorbs again from the air a portion of the water which it had lost, and soon warps like other wood.

Steam also has been used. I have not been able to obtain any accurate accounts of this process, and of its results; and still less have I been able to determine *a priori* the good effects which are to be expected from it.

The question thus remaining without answer appeared to me to be untouched, and I commenced by studying at the same time the nature and the cause of the inconveniences which I wished to remedy.

It was easily and quickly observed that the successive changes in volume which the wood underwent, were solely due to its hygrometric state, which again was completely dependent upon its porosity, and the presence in its tissue of matters which absorb water with avidity.

The best remedy against such an evil is evidently to close all the pores, and thus to prevent the air from depositing any thing in the wood, or from removing from it those minute portions of water which are the only causes of the expansions and contractions which it experiences.

In reflecting upon the means of obtaining this result, I was led to remark that the cracks did not begin to show themselves in unseason-

ed wood until an advanced period of its drying, and when it was on the point of losing the last third of the water which it contained. To preserve this in it, then, appeared to me to be an infallible means of preventing this play, which has heretofore been inevitable. I immediately proceeded to test, by experiment, the value of this idea.

All the facts confirmed my expectations. Wood kept always moist, within certain limits, by means of the penetration with a deliquescent chloride, remained unalterable in its volume, no matter to what atmospheric variation it was exposed; it changed its weight indeed, and that even in a greater proportion than wood in its natural state, but these changes produced no alteration of the form. The fibres remained in their places, the bonds which united them neither expanded nor broke, and the wood did not appear to have been subjected to any important influence.

In order to judge of the degree of protection which this process offered against the play, I caused to be constructed of prepared wood tablets of large dimensions, and of very little thickness, some of which were left as they came from the hands of the workmen, while others were painted upon their two faces.

I observed a year after they were prepared, that these tablets had remained unaltered, while others prepared in a similar way from wood in its natural state were strangely warped.

The employment of chlorides, thus advantageous in preventing the play of wood, reduces also materially the time necessary to season it. We thus economize all the time which is necessary for the evaporation of the last third of water which it contains.

This property thus preserved in wood, allows us to employ it with confidence for all kinds of furniture, and for the doors and windows of rooms, without having to fear those crevices so fatal to the best pieces of workmanship.

By introducing, mixed with the earthy chlorides, one fifth part of pyrolignite of iron, we insure preservation for an indefinite period.

Of the means of diminishing the inflammability and combustibility of wood used in building.

When I first satisfied myself that it was possible to preserve a certain moisture in wood by means of the earthy chlorides, I easily conceived that by means of the same substances I might not only diminish in a great degree its inflammability, but also render very difficult the combustion of its carbon, thus kept out of contact of the air by the fusion of the earthy salts at its surface, and in the mass.

These expectations were confirmed by experiment. I have satisfactorily proved that wood prepared with these salts inflames with great difficulty, and incinerates with exceeding slowness, so that they may be considered practically as incombustible, and may be employed as such under circumstances where this property becomes of great importance in constructions.

Thus two cabins exactly alike, were constructed, the one of prepared, the other of ordinary wood: to set fire to them equal quantities of combustibles were used. The latter was reduced to ashes, whilst

the inner walls of the former were scarcely carbonized, and the combustion ceased.

Facts of this kind, and others which I purposely omit, appear to me conclusive, and authorize me to think that wood prepared by means of the earthy chlorides is in such a state of resistance to inflammability, and to the maintenance of combustion, that the occurrence of fires is almost impossible, unless they be not only commenced but sustained by materials foreign to the construction of the building.

Of the introduction into wood of colouring, odorous and resinous matters.

In order to terminate the enumeration of the various substances which may be introduced by the vital force of aspiration, I must mention colouring, odorous and resinous matters.

The last two classes of substances can only be introduced in solution in alcohol diluted with water, or in various essences. The penetration is then easy, and the wood preserves the odour which has been communicated to it, with the same permanence as do those, the odours of which are natural. Wood impregnated with resins becomes extremely inflammable, and is with difficulty penetrated by water. I shall not dwell farther upon these properties.

As to the colouring of wood, it may be produced either by mineral or by vegetable matters. In the first case, the colouring matter is not immediately introduced, but we present to its absorption two bodies, the mutual decomposition of which determines the formation of a third, which is the coloured body. I have thus frequently obtained a blue colour by causing, in succession to penetrate, a salt of iron, and the prussiate of potassa. By following the same method, and varying the substances, we may also vary the colours produced.

Vegetable matters are not as easily introduced as the preceding. Certain woods even refuse to let them penetrate, however limpid may be the solution used.

When we reflect upon this, is it not natural to inquire whether it may not arise from a difference in size of the mineral and vegetable molecules? and might we not thus make use of the sap vessels of different species of wood to measure the respective sizes of these molecules?

Annales de Chimie, June, 1840.

The following additional process of M. Boucherie is extracted from a more recent journal.—Trans.

New researches upon the preservation of timber.

The process of penetration of wood by the vital aspiration, can only be executed during the running of the sap; and besides, that the time is limited to certain months in the year, the cutting of the wood at that season of the year deranges all established practices, and leaves in many minds the unfounded conviction that wood not cut in winter must, of necessity, be very subject to decay.

These considerations induced the author to seek for an economical means of penetrating wood in winter, and he has succeeded in discovering a mode of penetration differing from that by vital aspiration,

equally economical, complete, by means of which, in the depth of winter, and in a very short space of time, wood may be penetrated either in the bark, or after being squared.

This process, which is only applicable to wood newly cut, and sawn into pieces of any length, consists in placing the wood vertically, and adapting to its upper extremity bags of water-proof stuff, which act as reservoirs, into which are poured the saline, or other solutions, which may be chosen, so as constantly to supply fresh quantities to the wood. In the greater number of cases, the liquid speedily penetrates by the upper extremity, and almost at the same instant the sap escapes below. The process is terminated, when at the lower end of the wood the liquid is collected perfectly identical with that introduced at the upper end.

Bulletin de la Societè d'encouragement, pour L'Industrie Nationelle.

Table indicative of the Protective Action exercised by various substances against the Decompositions which certain very alterable Vegetable Matters undergo, when placed under favorable conditions of Moisture and Temperature.

All these experiments were made at the same time, with the same weights of vegetable matter, upon which was always poured the same quantity of liquid holding in solution different weights of the bodies of which we wished to ascertain the protective action. Equal conditions of humidity were preserved by placing the different substances in precisely similar vessels in the same place, into which were poured, at the same points of time, equal quantities of water to replace that which evaporated.

Wheat Flour.—62 grammes: Experiment begun Feb. 25th, 1838.

Simple Water.—To establish a point of comparison, I moistened the 62 grs.* of flour with 30 grs. of water, and observed that on March 5th the whole mass was covered with mould, and disengaged a large quantity of putrid gas.

Deutochloride of Mercury, (Corrosive Sublimate.)—Three experiments were made with this substance, and in the first the 30 grs. of water contained 2 decig. of deutochloride; in the second, 4 decig.; in the third, 6 decig. After two months of observations none of these matters presented any traces of alteration.

Sulphate of Iron, (Copperas.)—Five experiments were made with this salt; the 30 grs. of water containing respectively 2, 4, and 6 decig., 1 and 2 grs.

In all cases the mould was only retarded for a few days. It was complete upon the twelfth in all the experiments.

Pyrolignite of Iron, (Areometer 8°.)—Eight experiments—with from 1 to 8 decig. in 30 grs. of water.

With	1	decig. the	mould	appeared	upon the	10th
"	2	"	"	"	"	12th
"	3	"	"	"	"	15th
"	4	"	"	"	"	20th

* The abbreviation 'grs.' refers to the French weight, gramme, not to the English grain. Trans.

And it is to be observed that in all these experiments it only occupied, at the date indicated, a portion of the surface, and was not complete until eight days later.

With 5, 6, 7, and 8 decig. there was no mould upon April 25th.

Arsenious Acid.—Four experiments—the first with 2 decig.; second with 4 decig.; third with 1 gr.; fourth with 2 grs.

In the first case mould commenced upon the 10th of March and was complete on the 16th.

In the second, commenced March 12th, complete March 18th.

In the third, commenced March 15th, complete March 20th.

In the fourth, no alteration upon April 25th.

It must be remarked that in these last two experiments, the arsenic was chiefly in a *state of mere admixture*.

Saw-Dust of Green Wood.—Several experiments made with the saw-dust from green wood tend to the belief that 1 gr. of pyrolignite at 8° exercises a protection greater than that of 1 decig. of the deutochloride, which is contrary to the observations made upon flour, and beet pulp.

Moreover the dust of green wood is incomparably more alterable than that from dry wood, no matter with how much water we may mix the latter. This fact is remarkable.

95 grs. of the pulp of the beet, with the juice of which the substances tried were mixed in solution. The experiment commenced February 25th, 1838.

Pulp in its Natural State.—This experiment presented several points of mould upon March 3d; upon the 4th the mould occupied one-third of the surface; upon the 5th of March it was complete.

Deutochloride of Mercury, (Corrosive Sublimate.)—Six experiments with this substance; all indicated a complete protection, the least quantity used was 1 decig.

Sulphate of Iron.—In six experiments the least quantity of this salt used was 3 decig.; the greatest 1½ grs. Upon March 6th they were all completely mouldy.

Pyrolignite of Iron, (at 8° *Ar.)*—1 gr. of this salt was required to obtain a complete protection. Quantities less than 1 gr. had only the effect of retarding the decomposition more or less.

Pyroligneous Acid.—6 decig. of this acid completely prevented alteration. This experiment tends to show the powerful protective action of kreosote and the other essential oils which pyroligneous acid contains. It also points out the necessity of not saturating the acid with iron, which necessitates the separation of the kreosote.

Sulphuric Acid.—I employed from 1 decig. to 1½ grs. In the latter case it scarcely retarded the alteration for several days.

Sulphate of Copper.—This salt employed in the proportions of 1, 2, and 5 decig., 1 and 1½ grs., retarded the decomposition only for two days.

Sulphate of Zinc.—The results furnished by the sulphate of zinc were similar to those obtained from sulphate of copper.

Mr. Adcock's *Patent Spray Pump.*

Abridged from a Report in the Liverpool Courier of a communication made by Mr. Adcock to the Liverpool Polytechnic Society.

Mr. Adcock stated that his mind had been impressed, for some years past, with the difficulties and heavy expenses attendant on the present systems of pump-work, but that it was very far from his wish to disparage what has hitherto been done by others, or to undervalue, in however minute a degree, the great mechanical knowledge, and high scientific acquirements, which have been devoted to this subject. "On the contrary, sir," said Mr. A., "I could wish it most distinctly to be understood that, in so far as regards the present mode of raising from mines, *in a solid mass*, by pump-work, I do consider that our mining engineers, and especially those of Cornwall, have carried this branch of mechanics to quite as high a state of perfection as any other branch of the same science has been carried by other individuals, in the several other processes of productive industry. But it should be stated that, in the other branches of productive industry, as in the cotton, silk, woollen, flax, lace, hosiery, and iron manufactures, the various mechanical arrangements, their improvements and extension, *being above ground*, are placed prominently before the public eye; while those of the miner, *being beneath the surface of the ground*, are unseen and but little known beyond the immediate districts of their application. Nevertheless, we have an unerring test as to the value and efficiency of the improvements introduced into pump-work, by the knowledge we now possess of the greater depths to which mines can be worked, and the much greater quantities of water that can be raised from them than was done formerly."

At the Consolidated and United Mines, in Cornwall, for example, where the steam-engines that work the pumps make, on the average, eight strokes per minute, the quantity of water raised from the depth of the mine, equal to 180 fathoms, is not less than 3,800 gallons per minute. Hence, as the gallon is ten pounds, and the fathom six feet, the quantity of water raised per minute is not less than 38,000 pounds, or about seventeen tons weight, from a depth of 1,080 feet. If, therefore, the water so raised were allowed to flow at an average speed of one foot per second, or sixty feet per minute, it would form a rivulet five feet wide and two feet deep; and to raise that quantity of water per minute from the depth of the mine, not less than 2,000 horses of steam-engine power are employed, viz:—

3	engines, with cylinders		90	inches diameter each.
3	ditto	ditto	85	ditto.
1	ditto	ditto	80	ditto.
2	ditto	ditto	65	ditto.
1	ditto	ditto	30	ditto.

Each steam-engine working upon the high pressure, expansive, condensing system.

Again, at the Mold Mines, in Flintshire, the quantity of water

raised is more than double the amount of that at the Consolidated and United Mines, or about 8,000 gallons, or 35¾ tons weight, per minute; but then the depth from which the water is raised is not so great, being, on the average, only fifty fathoms, or 300 feet. In other words, and to compare the effect with that of the Consolidated and United Mines, in Cornwall, the quantity of water raised *per minute* from the Mold Mines, and from a depth of 300 feet, is sufficient to make a rivulet 10¾ feet wide, and two feet deep, flowing, as in the former case, at the rate of one foot per second, or sixty feet per minute, and to raise this large quantity of water per minute there are employed eight steam-engines and four overshot water-wheels, viz:—

1 engine, with	80 inch cylinder	and	22 inch	pump.
ditto	66	ditto	22	ditto.
ditto	64	ditto	18	ditto.
ditto	63	ditto	18	ditto.
ditto	60	ditto	18	ditto.
ditto	46	ditto	16	ditto.
ditto	40	ditto	12⅛	ditto.
ditto	36	ditto	10	ditto.

And the overshot water-wheels are each forty feet diameter, and four feet eight inches wide, working a twenty-two inch pump, and three pumps each, eighteen inches diameter, being one pump to each water-wheel.

The enormous weight of materials in a deep pit is far greater than persons unaccustomed to such investigations could possibly imagine. In illustration of which, said Mr. A., I will now exhibit to the Society the weight of materials for the pit-work of the eighty inch cylinder engine, at the Consolidated and United Mines in Cornwall, to which I have before had occasion to allude:—

	Tons.
Weight of pumps, windbore, &c., - -	161½
" wood-work, - - -	50
" moving work, - -	26
" pump rods, - - -	40¼
" main pump, - - -	94¾
" four balances and water lifts, -	96½
" load of water in pumps, -	38½

In my prior statement, said Mr. Adcock, respecting the Consolidated and United Mines, I mentioned the depth of the mines to be 180 fathoms, or 1,080 feet. But I should state, that such is the average depth from which the various pumps lift the water, and that some of the pumps lift from greater depths than others. The pumps under consideration, *for example*, lift the water from a depth of 290 fathoms, or 1,740 feet. At this pit there were, and probably are, twelve lifts, or pumps, the one below the other, with a length of stroke equal to eight and three quarter feet, and making, on the average, six and a half strokes per minute. The water raised at each stroke, and discharged at the top of the mine, was equal to 32½ gallons, or 325

pounds weight; and to raise that quantity of water, *at each stroke*, 300 tons had, each time, to be put in motion, and its *vis inertiæ* to be overcome. Hence, said Mr. Adcock, from what I have stated as regards the great weight of materials, and the large-sized steam-engine employed, it must be perceptible to every one, that the outlay for such a set of pump-work is severely great; and that any considerable reduction of the cost, and the subsequent annual expenses, cannot be regarded otherwise by the miner, than as a great boon conferred upon him.

Mr. Adcock here developed the several successive steps of the progression of his improvements, until, eventually, the complex ideas he originally had were reduced to the present state of perfection, as illustrated by his Patent Spray Pump.

"About two years ago," said Mr. A., "I secured a patent in England, for a new and very peculiar process of raising water from mines and other deep places, by employing the force of *condensed air*, confined within a cylinder, and alternating in its pressure, by the action of the piston within that cylinder, from forty-five to ninety pounds on the square inch.

"The invention, when it had been perfected, was submitted to the attention of miners of extensive experience, and approved of by them; and an order, which I had received, was in progress of execution, and a considerable outlay had been incurred by the parties, when I found it necessary to put a stop to all further proceedings, in consequence of a far more valuable and practically efficient discovery having been made by me, and which, if I may be allowed to use the words of an engineering friend of celebrity, is '*simplicity itself.*'

"For this last invention, I have secured patents in this kingdom, and in several kingdoms abroad.

"The invention is, as you will hereafter find, of an extraordinary character,—the happy result of an elaborate chain, or course of reasoning; and some of the *Prospective Advantages* of the *Patent* may be thus stated:

1. I employ neither pumps nor pump-rods.
2. There is but *one lift*, whatever the depth of the mine.
3. As there is but *one lift*, I employ neither clacks nor valves.
4. The water-pipes, or pump-trees, are made and put down at little cost; they are made of sheet zinc, bent into shape, soldered, and soldered to one another; hence, flanches and screw-bolts are dispensed with.
5. Being made of sheet zinc, the pipes, of course, are of light weight, and therefore require but few, and very slight, horse-trees to support them.
6. Wear and tear, comparatively speaking, there is none.
7. The steam engine that I employ is double-acting, and not single-acting. It is of much less size, and of much less power, and there is not occasion to erect it, as in pump work, at the pit's mouth. On the contrary, one engine may, with facility, be made to work two or three pits, at considerable distances apart.

8. I economise largely in the consumption of fuel; and in tallow, packing, and the leathering of buckets and clacks; also in labour.

9. The ventilation of the mine is produced free of cost. And,

10. In taking up the present plant of a mine, to put down the new, generally speaking, the sale of the old materials will more than repay the cost of the patented apparatus.

"Having thus described to you, gentlemen, in a cursory manner, some of the advantages to be derived from the adoption of the patented apparatus, I will, in the next place, detail the chain of reasoning which led to the discovery.

"In my first patented apparatus, I had, in deep mines, a series of "*lifts;*" the same as in pump-work; consequently as in pump-work I was obliged to employ clacks or valves. Knowing that such clacks or valves are at all times liable to derangement, I was desirous, if possible, to improve the patented apparatus, by substituting a new kind of valve, or one that would lessen the number of those employed. For that purpose, I invented and patented a beautiful, simple, and efficient valve; which, judging from its simplicity and value, together with its non-liability to go out of repair, must become universal in its application to water-works and steam engines.

"By that invention I could make one valve perform the duty of four clacks; and the water-way, which, in the patented valve, is unobstructed, was of the same size as that of the pump-trees.

"Encouraged by the success I had thus experienced, I was emboldened to attempt a still further improvement of the patented apparatus, by endeavouring to lessen, even to a greater extent, the number of clacks employed. Eventually I proposed to myself the question—'*Is it possible, in the raising of water from mines and other deep places, to do without clacks or valves altogether?*'

"I knew this desirable effect could not be produced, if the water had to be raised from the mines in a compact or solid state, as in pump-work. For in a pit, 1,000 feet in depth, the column of water being also 1,000 feet, the pressure of water against the sides of the pipe at the bottom of the mine, would be about 440 lbs. on each square inch, and no pipe that could be conveniently applied in practice, could resist that pressure,—I therefore, in the next place, questioned within myself, whether the water could not be brought up from the mine in a divided state; and the obvious reply to it was, if the water be brought up in a divided state, it must be in a state of vapour or of rain.

"The chain of reasoning, thus far continued, led me to investigate the descending velocities of drops of rain, compared with what those velocities should be, by the laws of gravitation; and I found that by the laws of gravitation, the rain ought to descend towards the earth with a speed constantly accelerating; so that, if the cloud was high from which it fell, it ought by its velocity, and consequently its *momentum,* to inflict evils of a serious nature on all animal and vegetable life.

"Then, how is it that such effect is not produced?

"Simply, by the resistance of the air. Each drop of rain, while in the cloud, may be considered to be in a quiescent state. It begins to

descend, from a state of rest, with a motion constantly accelerating, and thus it continues, until it acquires a certain amount of speed; from which time forth the motion of its descent is uniform.

"This uniformity of motion is produced by the resistance of the air; by its not being able to flow from beneath the drop beyond certain rates of speed under certain amounts of pressure, and the ultimate amount of pressure being determined by the weight of the drop. Hence, the drop descends with an accelerating speed at first, compressing the air more and more immediately beneath it, until the resistance and compression become equal to the weight of the drop—thenceforward its motion is uniform.

"I then proceeded to investigate the greatest descending velocities of drops of rain, and I found that, under ordinary circumstances, they were from eight to twelve feet in a second; from which time, the remaining portion of the reasoning was clear and decisive; namely, if water in globules, of a certain size and weight, like drops of rain, cannot, under ordinary circumstances, and in consequence of the resistance which they meet with in the air, descend with a greater speed than twelve feet in a second, then it is certain that if these drops were in a quiescent state, and a current of air were made to move *upwards*, at a greater speed than twelve feet in a second, these drops would flow upwards instead of downwards, *and that too, whatever the height.* Hence, the invention was perfected. I had only to try the experiment in secret. It far surpassed all that I had expected from it, and I forthwith secured the patents. But other effects have resulted in practice, which I never calculated upon nor expected. I have had an apparatus made, on the patent principle, to raise, agreeably to an order which I had received, forty gallons of water in a minute, forty-two feet in height. It was erected at the works of Messrs. Milne, Travis & Milne, at Shaw, near Manchester. The fan, which gave motion to the air, was only three feet in diameter, and one foot wide, and it made about nine hundred revolutions in a minute. Instead of raising forty gallons forty-two feet in height, it raised at the rate of one hundred and thirty gallons of water in a minute, one hundred and twenty feet in height.

"This effect, so much greater than it ought to have been for the power expended, caused me, for some time, much anxiety of mind. It seems to have arisen from a law of nature which is but little known or understood by practical men. I cannot, however, enter upon details here. It is sufficient for me to state in this place, that the natural tendency of the current of air upwards, from the fan at Shaw was one hundred and sixteen feet in a second; a speed, I believe, hitherto never obtained, or conceived to be possible, in the raising of weights.

"By the present mode of raising water from mines and other deep places, by pumps and pump-rods, and other mechanical contrivances, the water is raised through a series of pipes, in a compact or solid state; in other words, if the depth through which the water must be raised, by one pump or one lift, be one hundred feet, then the pipes, extending to that depth, will be full of water, and the whole column of water in those pipes will be lifted at one and the same time.

"A column of water one hundred feet deep, presses with a force of about forty-five pounds on each square inch of its base.

"Hence, if the diameter of the pump-bucket, or plunger, be twelve inches, and its area, as a consequence, one hundred and thirteen inches, the weight of water to be lifted, *at each stroke*, will be about 5,085 pounds.

"In a deep mine, therefore, containing ten such columns or lifts of water, below one another, and acted on at the same time, by the same pump-rod, extending down the shaft or pit of the mine, the weight of water to be raised will be very great, being not less than 50,850 pounds, or about twenty-three tons.

"Hence to lift such a weight of water, and to overcome the friction of the water in the pipes, together with the *vis inertiæ* to put such columns of water in motion, and to support its own weight, the pump-rod must be made of great strength; and the steam engine, water wheel, or other prime power, by which the effect must be produced, must be of large size and great power.

"By consequence of that *vis inertiæ*, the friction and the great weight to be put in motion—and when steam engines are employed, the alternate action or reciprocation of the great lever or beam of the engine—the number of feet of *effective* strokes, made per minute, is comparatively small, being generally in deep mines, from about fifty to eighty feet. To explain this more fully, the whole mass of water in the ten columns, having to be raised at one and the same time, and therefore being equal in weight to one column of water of the same diameter and 1,000 feet in depth, may be considered as being lifted in the mass, through a distance of fifty, or from that to eighty, feet in a minute. Whereas by my '*Improvements in raising water from mines and other deep places, or from a lower level to a higher, which improvements are applicable to the raising of liquids generally, and to other purposes,*' I do not raise water or other liquids in the mass, nor do I find it necessary to exert a pressure, at one and the same time, of forty-five pounds on each square inch, when the height to which the water must be raised is one hundred feet; nor do I raise water by pumps and pump-rods; but in the manner now to be described.

"That is to say, by the aid of a steam engine, water wheel, or other prime mover, I give motion to a fan, or fanner, (such as is used very commonly by foundry men, engineers, mill-wrights, and others, to force a current of air into cupolas and other kinds of furnaces,) or to the piston of a blowing cylinder, (such as is used by iron masters and makers of iron, to force a current of air into blast furnaces, for the reduction of ores,) and, by aid of such fan or fanner, or blowing cylinder, I condense atmospheric air that it may, when liberated from its confinement, have a tendency to escape into the atmosphere with a velocity due to its pressure.

"When atmospheric air is condensed to a quarter of a pound pressure per square inch beyond the atmospheric pressure, and is liberated from its confinement, it moves, or has a tendency so to do, at the rate of one hundred and seventy-three feet in each second of time; at

half a pound pressure per square inch, the speed due to the pressure is two hundred and forty-five feet per second; at three-quarters of a pound pressure, two hundred and ninety-six feet; at one pound, three hundred and forty feet; at a pound and a quarter, three hundred and seventy-five feet; at a pound and a half, four hundred and ten feet; at a pound and three-quarters, four hundred and thirty-six feet; at two pounds, four hundred and sixty-seven feet; at three pounds, five hundred and fifty-five feet; at four pounds, six hundred and twenty-four feet; and at other pressures, with other velocities or rates of speed, as may be known by reference to, or consulting the Treatises that have been published on, the science of Pneumatics.

"Now, instead of raising water in the mass, as herein before described, by pumps and pump-rods, and such like contrivances, I avail myself of the mechanical effects that may be obtained from the velocities of the air, as due to the pressures herein before made known, or any other pressures that circumstances connected with mines, in different localities, may prove to be desirable.

"I cause the water that must be raised from the mine, or from a lower level to a higher, to be dispersed and carried up in drops, like drops of rain; but the velocity of those drops *upwards*, in consequence of the velocity of the air, is far greater than the *descending* velocities of rain.

"For drops of rain, when not receiving an impulse from winds, can only descend through the atmosphere with a speed of about eight feet in a second, when the diameter of each sphere or drop of rain is the hundredth part of an inch. When the diameter of the drop is the sixteenth part of an inch, the greatest descending velocity through the atmosphere is about seventeen feet in a second; and the velocities in a second, through the atmosphere, for drops of rain of other diameters, may be thus stated: for drops of rain an eighth of an inch diameter, twenty-four feet; for drops three-sixteenths of an inch diameter, thirty feet; and for drops a quarter of an inch diameter, thirty-four feet per second. Whereas, the velocity of the air, when allowed to escape from a pipe upwards at one pound pressure per square inch beyond the atmosphere, and without making any deductions for the friction against the sides of the pipes, is about three hundred and forty feet in a second. But it should be stated that, when the air is commingled with the water that must be carried up by it from a mine, or from a lower level to a higher, its motion, to a certain extent, is retarded. The velocity of the drops of water *upwards*, however, by this mode, or by these modes of raising water from mines and other deep places, is far greater than the velocities at which rain usually descends, as herein before has been described."

Mr. Adcock's invention has been put down, *practically*, at the Pemberton Pit, Wigan, which is under the management of Mr. Robert Daglish. The pit is one hundred yards deep, and Mr. Adcock proposes to bring up from that depth from two hundred and forty to three hundred gallons per minute; and, from a preliminary trial already made, there appears to be no doubt as to the success of the invention.

London Mech. Mag., June, 1841.

TO BE CONTINUED.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1840.
With Remarks and Exemplifications by the Editor.

1. For a *Self-Acting Mule for Spinning;* William Mason, Taunton, Bristol county, Massachusetts, October 8.

It would require the whole of the specification and drawings of this instrument to make known the peculiarities upon which the claims are dependent, and we shall not, therefore, attempt any analysis of it. Such a machine is necessarily very complex, and in many of its parts it must be similar to others for the same purpose which have been patented in England and in the United States.

2. For an improvement in *Piano Fortes;* Jonas Chickering, Boston, Massachusetts, October 8.

This patent is obtained for an improvement in iron framed pianos, and the improvement consists in attaching or combining the bridge, over which the strings pass, to the straining pins, and the socket, through which the damper wires pass, to the iron frame, by casting them thereon, or by casting the whole together in one piece.

The claim is confined to this device and is expressed nearly in the above words.

3. For an improvement in the machine for *Hulling Rice* and other seed; William C. Grimes, York, York county, Pennsylvania, October 8.

The following are extracts from the specification.—"For hulling and scouring rice no principle of action has been found, perhaps, more applicable or efficient than the percussion of pestles or stampers acting upon a mass of it more or less confined. But the manner of applying this action as heretofore is imperfect, in as much as all reciprocating motion in a machine for this or other similar purpose must necessarily be."

"In my machine the motions of all the moving parts are rotary, whilst the action upon the rice or other seed is similar to that of a pestle upon a dense and partially confined mass of it; while at the same time, it is constantly receiving at one point and discharging at another, no time being lost for that purpose."

"This machine consists of a hollow metallic cylinder which revolves rapidly on its own axis; within this cylinder, where the hulling is effected, revolves another in the same direction, and about as much oftener as it is smaller in diameter. The axes of these cylinders are very eccentric, the great difference in their diameters allowing of this arrangement."

The small cylinder is armed with six or more rows of long teeth, and its axis is equally distant between the axis and periphery of the

large cylinder, so that its teeth will nearly touch the inner periphery of the large one. The upper end of the large cylinder is open, and is attached to its shaft at the bottom alone, so as to allow of its turning independently of the small one, the axis of which is permanent, and its shaft being attached to the frame at the top alone. The grain is fed in at the top and discharged at the bottom. As the large cylinder revolves with considerable velocity the centrifugal force will concentrate the rice around its inner surface; and as the axis of the small cylinder does not revolve with the large one, its teeth act upon all the rice thus concentrated.

The claim is to the "mode of hulling rice, seed, or grain, by means of the combined action of a rapidly revolving hollow cylinder and one or more smaller cylinders armed with pins, teeth, or projections, revolving upon a fixed axis and operating as set forth, it being eccentric with, and within, the former, where the hulling and scouring are effected; the said projections acting upon the rice while it densely lines, by centrifugal force, the inner surface of the hollow cylinder as before specified. I claim the application of centrifugal force to this purpose, applied in the manner specified."

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4. For improvements in the *Process of Manufacturing White Lead;* Horace Cory, Great Britain, October 8.

The first improvement claimed under this patent is the combination of the process of making lime with that for making carbonate of lead, or white lead, whereby the carbonic acid gas, evolved in the first process, is made to pass through a solution of lead and convert it into carbonate.

The second improvement claimed is for a mode of submitting a solution of lead, prepared in any known manner, to a current of carbonic acid gas. A chamber is so divided by partitions that the gas will pass down one space, then under the partition up a second space, then over a second partition, and so on, through any given number of spaces, and then out at the chimney. Each space, in which the gas descends, is covered with a perforated plate, and through the perforations in these plates the solution of lead drops, and in passing down it comes into contact with the carbonic acid gas and is converted into carbonate of lead. The solution thus impregnated with carbonic acid gas, passes into precipitating vats, and after the carbonate of lead has subsided, the surplus solution is pumped back, and is again passed through the impregnating chamber.

The claim is, first, to the "combining of the process of making white lead with the process of making lime, whereby the carbonic acid gas evolved in the latter process is beneficially applied in place of permitting it to pass into the atmosphere. And secondly to the mode of submitting suitable solutions of lead to the action of carbonic acid gas as above described."

5. For *Evaporating Solutions, Decoctions, &c., for the purpose of Concentrating them;* James W. W. Gordon, Baltimore, Maryland, October 8.

The patentee says, "The object of my improvement is principally to obviate the danger of injuring the preparation, which in articles of great delicacy sometimes takes place, by the application of the heat of a water or steam bath only; and this I effect by means of a machine which produces rapid evaporation at the ordinary temperature of the atmosphere."

This machine consists of a table either flat or convex, which is made to revolve either horizontally or vertically, and upon which the solution, &c., is suffered to percolate. The evaporation is accelerated by thus passing the fluid through the air with considerable velocity.

The claim is to the "employment of a revolving table, constructed and operating substantially in the manner of that herein described for the evaporating of decoctions, infusions, or solutions, and the producing of pharmaceutical extracts without artificial heat, as described."

The extracts thus formed are very favourably spoken of by those who have used them; they are not only superior in colour and general appearance to those made by heat, but in many instances retain those qualities upon which their value is dependent, in a manner much more perfect.

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6. For an improved *Flyer for Twisting Silk, &c.;* Edward L. Young, Norfolk, Virginia, October 8.

This flyer, instead of having the two guide wires run out their whole length parallel to, and at equal distances from the axis, has one short and one long guide wire—the short wire, or arm, extends as far only as the middle of the bobbin, and the longer arm extends to some distance beyond the end of the bobbin, and is there curved so as to bring the guide in a line with the axis of the bobbin—the guide wire being sufficiently long to admit of putting on and taking off the bobbin without moving the flyer. A ring is attached to the two guide wires of this flyer, near the extreme end of the short arm, to prevent the centrifugal force from throwing out the guide wires which constitute the flyer.

The claim is to this method of constructing the flyer.

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7. For an improvement in the *Method of Raising and Lowering Venitian Blinds;* John Weir, city of New York, October 8.

The improved method of raising blinds consists in attaching the upper end of the cords, that pass through the slats, to a roller at the top, which is turned by two cords that wind and unwind on a barrel at the end of the roller. There is a ratchet wheel on one end of the roller, into the teeth of which a pall catches. A cord is used to disengage the ratchet to allow the blinds to descend. By means of this arrangement the blinds may be raised and lowered, and retained

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at any point desired, without attaching the cords to knobs as heretofore.

The claim is to the "mode of raising and lowering venitian blinds, and retaining them at any height without the operation of fixing the cords, by means of the combination of the blinds, the cords passing through the slats, the roller, the barrel on the end of the roller, and the cord passing around the same, and the ratchet wheel and catch, as described."

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8. For an improvement in the manner of constructing *Railway Tracks;* Benjamin H. Latrobe, Civil Engineer, Baltimore, Maryland, October 8.

For a description of the railway which is the subject of this patent, see vol. i, third series, p. 173.

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9. For a new *Manufacture of Cloths from worn out Wool or Silk Goods;* Reuben Daniels, Woodstock, Windsor county, Vermont, October 8.

(See specification.)

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10. For an improvement in *Fire Arms;* Silas Day, city of New York, October 8.

This patent is obtained for an improvement on that kind of fire arms that load at the breech, and it consists in making a curved chamber at the breech, which opens at the side of the barrel, for the reception of the load. The side aperture is closed by a valve which works on a pin and is provided with a handle and catch, the valve works in a slot made in a block of iron that projects from the side of the barrel, and in which block a part of the curved chamber is made.

"I am aware," says the patentee, "that guns have been made to load at the breech by having a sliding valve to close the aperture through which the charge is inserted, but not constructed like the plan herein described, and therefore I do not claim the principle of loading at the breech as my invention, but what I do claim as my invention, and desire to secure by letters patent, is the curved chamber, and in combination therewith the sliding valve and its appendages, consisting of the slot and lever, for the purpose, and in the manner herein described."

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11. For an improvement in the machine for *Cutting the Teeth of Metal Combs;* Joseph C. Ives, Bristol, Hartford county, Connecticut, October 8.

The object of this improvement is to prevent the tooth, which is being cut, from curling from the operation of the saw ; an effect well known to all workers in metal. A stud is to be added to the sawing machine, which stud works on a joint pin, and is borne up by a spring; it is distant from the saw the thickness of a tooth, so that the tooth which is being cut, is held against the face of the saw, and is thus

prevented from curving. As the saw cuts into the comb plate the stud yields and allows the plate to move towards the saw.

The claim is to "pressing the tooth while cutting against the side of the saw in the manner and for the purpose specified."

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12. For improvements in the manner of constructing *Locomotive and other Carriages;* Alfred C. Jones, city of Philadelphia, October 10.

In the specification on this patent various improvements are proposed; the first of these improvements has for its object the more perfect attainment of an equal bearing of the driving wheels on the road, using therefor, the ordinary sized springs of locomotives, or other carriages, but these being so arranged and combined as to produce the intended effect, on being applied to carriages of four or of six wheels.

For a four wheeled carriage the patentee employs two bell cranks, or bent levers, on each side of the carriage. The bearings of the two are near together, and one arm of each runs out horizontally, the other vertically, either up or down. The ends of the horizontal arms bear upon the sliding boxes, in which the gudgeons of the axles work; and between the two vertical arms is placed the elliptical spring. When the principle is applied to a six wheeled carriage, four such levers are employed, the ends of the two inner levers resting upon the sliding box of the axle of the middle wheels.

The claim to this improvement is as follows, viz: "What I claim as my invention in this part of my improvements in railroad carriages of various descriptions, is the application of the bell crank or bent lever between the axle boxes and double or single elliptic springs, standing vertically and combined and arranged as above set forth."

The object of the second improvement is to throw a larger part of the weight of the carriage on the wheel which is passing over an elevation of the road, when it has become uneven, and thereby to tend to relevel it. To effect this, the ends of a bar, on each side of the car, rest on the sliding boxes of the front and rear axles, and the connexion, between this bar and the spring, is by means of two straps, or lugs, so that when one wheel is lifted up, the connexion between the bar and the spring is transferred to the strap, lug, or other means of connexion, nearest this wheel, and thus the larger part of the weight has to be sustained by it.

The claim to this second improvement is to the "manner of applying the principle of transferring a portion of the weight of the carriage or load from one wheel to another, so as to increase the pressure upon the wheel which may be upon an unduly elevated part of the rail, and decrease it on that which may be in a hollow or depression."

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13. For a machine for *Reducing worn out Cloths of various kinds to the state of Wool to be spun into yarn for the Manufacture of Cloths;* Reuben Daniels, Woodstock, Windsor county, Vermont, October 10.

This machine is, in its general features, similar to the paper engine

for dressing pulp in the manufacture of paper, excepting that the cylinder, instead of being armed with knives, is studded with teeth, and works against a concave of small rollers, also studded with teeth. The worn out cloths, or silks, may be first reduced into shreds by toothed cylinders, or other apparatus, and then put into the water, in which the lower part of the cylinder and the concave of rollers work, and thus brought under the action of the teeth, which take out the twist.

Claim.—"Having thus fully described the manner in which I construct my machine for reducing woolen rags and also worn out silks into fibrous stock, fit to be re-manufactured, it is to be understood that I do not claim the mere use of cylinders furnished with teeth, or points, for the purpose of tearing or reducing woolen or other rags into fibres, but what I do claim as constituting my invention, and desire to secure by letters patent, is the use of cylinders furnished with teeth or points, and operating under water, or other fluid, in a machine similar in its general form to that used by paper makers in preparing their pulp, but combined with the concave of small cylinders, and operating in the manner described."

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14. For an improved *Cooking Stove;* R. G. Cochran, Francistown, Hillsborough county, New Hampshire, October 10.

The patentee says, "that his improvement is in the manner of constructing a cooking stove, by which it is adapted to the heating of air, and to the conveying of air so heated for the warming of apartments in dwellings."

An air chest is made between the fire chamber and the descending flue, in front of the oven, so that the draught passes up in front of the air chest, over the top, down between the back of the air chest and front of the oven, &c. &c. Air is admitted to the air chest by a pipe at the side or bottom, and conducted out through a trunk which extends over the oven, and thence through a pipe to the apartment to be heated. The oven, when not used for baking, is employed as auxiliary to the air chest by being provided with a pipe to admit cold air into it, and an aperture, governed by a valve, for conducting the hot air to the trunk which conveys the hot air from the chest. These various pipes and apertures are to be governed by valves or dampers.

The patentee says, "I claim the manner in which I have combined and arranged the air chest for heating air with a cooking stove, rendering the oven or ovens of such stoves auxiliary thereto by converting them into air heating chambers, and connecting them with the air chamber first named, in the manner and for the purpose herein set forth."

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15. For an improved machine for *Working and Pressing Butter;* Titus D. Gail, Eden, Erie county, New York, October 10.

This machine is for working and pressing butter to separate it from the buttermilk and to press it into balls or lumps of definite size. The machine is described as consisting of a table pierced with two square

holes, fitted with pistons, working from below. Above these perforations a trough is formed by two side boards, in which work three pistons, one vertically and the other two horizontally, one at each end; the three being so connected that by pressing down that which is vertical, the others are forced apart, and when it is drawn up they are pressed together, and thus the butter is alternately worked and the buttermilk separated from it. The butter is then forced into the square holes, or boxes, to form it into balls, the size of which will be regulated by the pistons that work in said boxes.

Claim.—"What I claim is the combination of the horizontal pistons working within the side boards, and operated by the levers, and also the vertical block, or piston, attached and operated by the lever, likewise the table constructed with boxes, all as described; and in combination therewith the box or mould pistons and the slide, for the purpose set forth."

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16. For an improvement in the method of *Cutting Screws on the Rails of Bedsteads;* Jacob Lindley, Cynthiana, Harrison county, Kentucky, October 10.

The ordinary method of cutting screws upon the ends of bedstead rails, is well known to all who are acquainted with the making of such articles. In the improved mode, the rail is held in the middle by a clamp attached to a bench, on each end of which there is a puppet head in which works a screw, mandrel, or shaft, provided with a winch on its outer end, and on the inner end of each of these is fitted a socket, very similar to those usually employed for cutting wooden screws, excepting that they are made of steel, and the cutter is formed by it, instead of being attached thereto. These sockets are fitted on to the inner ends of the screw, mandrel, or shaft, by a socket, and secured by a thumb screw, by means of which the precise point at which the threads, on each end of the rail shall end, can be regulated. That end of the socket, on which the cutter is situated, is beveled off, and the cutter is so formed as to cut under the shoulder.

The claim is to the "manner of forming the cutters for cutting the screws on the ends of the rails, by making them a part of, and one with, the sockets, or female screws. Also, the manner in which I have combined and arranged these sockets, the screw shafts, and standards (puppets) with each other, for the purpose set forth."

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17. For a machine for *Pricking Leather preparatory to sewing;* Samuel Sheldon, Cincinnati, Hamilton county, Ohio, October 10.

This machine consists of a clamp for holding the leather, attached to a sliding carriage, and a slide to which the awl is attached, said awl having a sliding reciprocating motion at right angles to the motion of the leather in the clamp. The awl slide is moved by means of a crank pin on a wheel attached to the fly wheel shaft, and a strap, operated by the awl slide, passes over a roller and has a sliding plate suspended from it, provided with a pin which may be shifted along a set of holes; as the sliding plate is worked up and down by the strap, the

pin strikes against a handle and thus actuates a rag wheel, from which motion is communicated to the clamp carriage; the degree of this motion may be regulated by shifting the pin on the sliding plate, the distance apart of the holes pricked in the leather being thereby determined at pleasure. The motion of the awl and the leather may also be regulated by shifting the crank pin on the wheel, by which the awl slide is actuated.

The claim refers by letters to the drawings, but it is confined to the arrangements above indicated for regulating the feed which moves the carriage and clamp.

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18. For improvements in the *Machine for Pricking Leather preparatory to sewing;* Samuel Sheldon, Cincinnati, Hamilton county, Ohio, October 10.

The claim under this patent is to the "manner of combining and arranging the apparatus for moving the awl back and forth, as described, said combination consisting of the strap shaft, with the strap attached thereto, and the pinion thereon, taking into the rack on the awl shaft, the metal rods and the spring, substituted for the leather strap and the spring in his patent of August 3rd, 1839. And also to the manner of combining the screws and swivel-nuts with the clamp for holding the leather."

The difference between this and the first named machine is principally for the purpose of adapting it to the heavier kinds of work, such as thorough braces, &c.; the particular manner of effecting this we shall not attempt to describe.

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19. For improvements in the mode of *Supplying Steam Boilers;* Benjamin M. Hyatt, Wilmington, Delaware, October 10.

A cylinder is placed above the boiler, with one pipe leading from the bottom thereof nearly to the bottom of the boiler, another from the upper part of said cylinder to the top of the boiler, and a third either to a cistern above, or a well below. All these pipes are provided with stop cocks to be worked at proper intervals by the engine. When the third pipe connects the cylinder with a well below, the operation is as follows, viz: steam is admitted from the boiler to the cylinder through the first named pipe, and by its condensation forms a vacuum in the cylinder, which is to be filled with water from the well, by atmospheric pressure through the third pipe; steam is then again admitted through the first pipe, to make the pressure above the water in the cylinder equal to the pressure in the boiler, and the water in then admitted to the boiler through the second pipe. When the third pipe leads from the cylinder to a cistern above, instead of a well, steam is admitted into the cylinder only for the purpose of equalizing the pressure.

The patentee says, "I am aware that steam boilers have been constructed with a supply cistern, in some respects like mine, that is with a chamber or cistern placed above them having tubes governed by

stop cocks connecting the top and bottom of the cistern with the boiler for the purpose of equalizing the pressure of the steam upon the water and allowing it to descend into the boiler as herein described. I do not, therefore, claim the raising of water by the condensation of steam in a vessel for that purpose; but what I do claim is the combination for raising water and supplying a steam boiler therewith, as herein set forth; that is to say, by the use of the pipes leading from the cylinder into the boiler, combined with the respective stop cocks connected with the cylinder and the boiler, said cocks being operated by the stroke of the steam engine in any convenient way, so as to allow the steam in the cistern at every stroke of the piston to come in contact with the tube leading to the well, so as to produce a rapid condensation, and a consequent vacuum for the admission of water from the supply reservoir, or well.

I also claim the combination and arrangement as above set forth for supplying water to the boiler from the cistern, or from any sufficient source above the boiler, the combination and the action of the respective cocks by the power of the engine being in all respects as herein set forth, with the exception of the apparatus for raising the water from a well or reservoir below the boiler.

I wish to be understood, also, as not claiming in this the raising of water into a cistern connected with a steam boiler by atmospheric pressure, steam being admitted from the boiler into the cistern and condensed as in my arrangement, unless the mode of supplying the boiler from the cistern by balancing the pressure of the steam be employed as herein described."

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20. For an improved mode of *Propelling Boats on Canals;* Mellen Battel, Albany, New York, October 14.

The improvement proposed is in the well known mode of propelling canal boats by means of a wheel running on the bottom of the canal. The wheel is to be made with paddles, in the usual way, and there are to be projections on the outer edges thereof to catch and hold on to the bottom of the canal, so that in shallow water the wheel may be employed to run on the bottom, and in deep water to act merely as a paddle wheel. The wheel is placed between two boats, or between the sections of what is usually called a twin boat; it has its bearings in two vibrating balance beams, to which the engine is also attached, so that the wheel may accommodate itself to the inequalities of the bottom.

The claim is to the "forming of the combined ground and paddle wheel, so as to run upon the bottom of a canal and to propel the boat by the hold or friction of the cross bars and the rims alone, and when raised from the bottom to effect the propelling by the buckets, or paddles; said wheel being connected and combined with a vibrating frame within the body of the boat, which frame also sustains the steam cylinders in the manner set forth, and the respective parts concerned in the operation of propelling being arranged and operating substantially in the manner herein described."

21. For a *Cooking Stove for Burning Bituminous Coal;* Wm. B. Lawrence, Cincinnati, Ohio, October 14.

The patentee remarks that "one of the principal causes of complaint in the operation of baking in cooking stoves is the result of the accumulation of soot and ashes in the flues, which being very bad conductors of heat prevent the heating of the oven plates, the air from the fire making its escape without communicating its heat where alone it is wanted; to obviate this difficulty is the main object of my improvement.

"Said improvement consists, in the first place, in the forming of a scraper which may be cast in one piece, or which may be made by the uniting of several plates together so as to constitute one piece, and which, when in place, shall occupy the flue space above, below, and on each side of the oven, and shall have rods attached to it that pass through holes in one of the side plates of the stove, terminating in handles on the outside, in such manner as to admit of the moving of said scrapers back and forth within the flues, and simultaneously to remove the accumulated soot and ashes therefrom on every side. And secondly, for the purpose of discharging the soot which has been scraped off from the flues, I make perforations, or longitudinal openings, through the iron plate which forms the lower side of the bottom oven flue, and place under this plate a drawer, or other receptacle, into which the soot and ashes shall fall, and from which they can be readily removed whenever the same may become necessary."

The claim is to the "manner of cleaning the flues surrounding the ovens of stoves of various kinds by the use of a scraper, cast or otherwise made in one piece so as to surround the oven on four sides; and in combination therewith the respective openings in the bottom plate leading into the draw, or receptacle, for the soot and ashes."

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22. For an improvement in the *Spark Arrester for Locomotive and other Carriages;* Randall Fish, New York city, October 14.

In this spark arrester the usual chimney is surrounded by a drum divided into chambers by vertical partitions running from it to the inner periphery of the drum. The draught is conducted through a pipe into the first chamber, from this chamber into the next through a pipe in the partition, and so on until it has passed through all the chambers, from the last of which it is conducted back into the chimney through an opening near the top of the drum. The pipes that form the communications, from the chimney to the drum, and from chamber to chamber, are inclined downwards at an angle of about forty-five degrees. The drum is provided with a receptacle at the bottom to receive the sparks.

The claim, if given, would be merely a repetition of the foregoing arrangement, and we do not, therefore, insert it.

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23. For an improved *Ever Pointed Pencil Case;* Thomas Woodward, city of Brooklyn, New York, October 14.

The object of this improvement is to prevent the heads and points

of pencil cases from becoming loose, where they are screwed on to the body of the case, and this is to be effected by the introduction of a sliding bolt at top and bottom, which slides within the case and revolving tip, and catches into a notch made in the head and point for its reception. Instead of the bolt the patentee describes another method of preventing the point from becoming loose, which consists in forming a conical joint, instead of a square shoulder, on the point and revolving tip where the two are united together by a screw.

The claim is to the "employment of a bolt, or catch, formed and operating substantially as described, in combination with the ordinary screw for securing the heads and points of such cases, and also, in lieu of such bolt or catch, at the point and tip, the combining of the cone with the ordinary screw, in the manner and for the purpose set forth, and applied to the ever pointed pencil case."

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24. For an improvement in the manner of making the *Wheels of Railroad Carriages;* Albert Fuller, Providence, Rhode Island, October 14.

In this wheel the rim is to be cast with a chilled flanch, and the tread is sunk to receive a wrought iron tire, which is put on while hot, so that the contraction of the metal as it cools will secure it in place; and it may be further secured by bolts.

Claim.—"What I claim as my invention and desire to secure by letters patent is, placing the tire in the sink in combination with the cast iron chilled flanch, for the purpose and in the manner described."

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25. For a machine for *Cutting Vegetables;* George J. Neveil, Rising Sun, Philadelphia county, Pennsylvania, October 14.

The machine described by the patentee is for cutting vegetables for the feeding of cattle, and it may be applied also to other purposes; it consists of a hollow truncated cone, provided with cutters, and revolving on an horizontal shaft or axis within an inclined hopper provided with a sliding gauge on the side towards which the cutters revolve, for the purpose of aiding to regulate the cutting apparatus.

The general nature of the improvement will be understood by reference to the following claim, viz: "I do not claim a hollow truncated cone, inclined hopper, sliding gauge, or frame, but what I do claim as my invention, and which I desire to secure by letters patent, consists of the before described mode of constructing the hollow truncated cone of cutters for cutting vegetables, roots, &c., namely by means of the open and solid beads grooved on the faces towards each other to admit the ends of the segments and knives, and held together by rods and screws arranged in such a manner that they can be loosened at pleasure for the purpose of setting the segments nearer to or farther from the cutting edges of the knives, for the purpose of cutting coarser or finer and again tightened to hold them securely in the position in which they are set, all as described."

26. For a method of *Rendering Hats Buoyant, to be employed as Life Preservers;* Samuel White, England, October 14.

A water proof chamber is made in the upper part of a hat, cap, or bonnet, by means of a division placed sufficiently high to be beyond the reach of the top of the head. The whole of the hat, &c., is made water proof, and the lining is provided with a tube, so that by drawing out the lining, and inflating it with air, through this tube, the whole will have considerable buoyancy.

The claim is, "first, to the making of hats, caps, and bonnets with a space water proof, as above described. And secondly, to the application of a water proof lining for the purpose of preventing persons from sinking in the water.

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27. For an improvement in the *Cooking Stove;* James Parmalee, Ogden, Monroe county, New York, October 14.

The improvement claimed in this patent is for an arrangement of the dampers and plates to give a new direction to the draught. In addition to the front set of boilers usually employed in cooking stoves there is another set over the forward part of the oven. Between the bottom of these boilers and the top plate of the oven, there is a plate which extends from the back plate of the fire chamber to the back of the stove, and the passage between this plate and the top plate of the stove is closed, when desired, by a damper, and that between this plate and the top plate of the oven is closed by a partition running across the stove; the partition and the damper being behind the second row of boilers above mentioned. The intermediate plate is provided with two openings, one in front and the other behind the partition. When the oven is not in use the damper is to be turned down, and then the draught passes under the boilers and directly out to the smoke pipe near the back; but when the oven is to be heated, the damper is closed, and the draught then passes under the boilers, through the hole in the intermediate plate, over a part of the oven, down the front, under the bottom, up the back, then over the other part of the top, and through the second hole in the intermediate plate to the pipe. The claim is limited to this particular arrangement of the flues, partitions, and dampers.

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28. For a *Boiler for Heating Water for Culinary Purposes, and for Generating Steam;* Daniel L. Pickard, Hartland, Niagara county, New York, October 14.

The furnace in this apparatus is placed within the boiler, which may be cylindrical, and the space between the furnace and the cylinder, at the sides and top, is occupied by alternate flues and water chambers, formed by means of convolute plates, so that the draught passes up over the top of the first water chamber, on each side, down between the first and second water chambers, and up between the second and third, and thence out at the chimney, which chimney passes

through the outer water chamber. All the water chambers open into a water space at the end.

Claim.—"Having thus fully described the manner in which I construct my boiler, what I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the respective parts, consisting of the exterior case, the furnace, the convolute flues and water spaces, and the end water space, or bulk-head, as described."

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29. For a *Machine for Crozing and Chiming Staves for Barrels, &c.;* Charles F. Beverly, Salem, Columbiana county, Ohio, October 16.

The croze and chime of staves are to be formed by this machine, on the face of the block from which the stave is to be cut. On the face of the gate, to which the knife, that cuts the stave, is attached, there are two cutters of the form of the croze and chime, placed as much farther back than the knife as will form the desired thickness of the stave; these cutters shear against the edge of a plate having depressions to correspond with their shape, said plate is attached to a sliding platform, which is acted upon by a spring to force the plate into its proper position to insure cutting, and by means of cam pieces, attached to the gate, between the stave knife and cutters, it is pushed back, clear of the stave knife, at each operation.

The claim is to the manner of forming the cutters, for cutting the croze and chime in combination with the depressions and bevels on the plate against which they cut.

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30. For improvements in the *Machine for Planting Corn;* Martin Nichols, Clearfield, Clearfield county, Pennsylvania, October 16.

The description of this machine is of great length, and the claims refer to the drawings, and could not be understood without them.

The corn, or other seed, is to be dropped by means of cups attached to a band passing around two drums, in a manner well known to those who are conversant with planting machines. Two rows are to be planted simultaneously, one on each side of the machine. The first claim is to the manner of arranging a plough beam, by attaching it, by a joint pin or bolt, at one end to the frame of the machine, and at the other end to a sword piece which passes up through a mortise in the frame—the depth to which it shall sink being regulated by a pin. The second claim is to the combining with the above a windlass and levers by means of which the plough may be raised, and a roller attached to the end of one of the levers, depressed, to relieve the plough and coverers.

The third claim is to the combining with the plough and coverers two stampers which stamp the earth after the rows have been covered—they are attached to levers and worked up and down by means of tappets on a revolving shaft.

The last claim is to the manner of arranging and operating a brush or striker for clearing the cups of any surplus grain. The brush is

inclined plate, or ledge, on the bottom of a drawer, which, as the drawer is pulled out, actuates a lever which acts on a sliding plate that is connected, by means of rods and bell cranks, to a plate, called by the patentee a segment plate—this plate is hung on a joint pin and has a weight suspended to it at one end, whilst the other end catches on to the crank handle of an alarm and prevents it from ringing. The object of this arrangement is to disengage the segment plate from the crank of the alarm when the drawer is pulled out by any one not acquainted with the arrangement.

The claim is to the "combination and arrangement of the oblique plate, or ledge, on the bottom of the money drawer; with the vertical lever, horizontal plate, rods, bell crank, and segment plate for springing the alarm when the money drawer is moved."

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36. For a machine for *Hewing Plough Beams,* and which is applicable also to other purposes; Draper Ruggles, Joel Nourse, and John C. Mason, Assignees of Elbridge G. Mathews, Worcester, Massachusetts, October 22.

The hewing is performed by means of gouges affixed to the face of a wheel towards the edge thereof. The piece of timber to be hewed is placed on to a sliding carriage, which is put in motion by the machinery in any known manner. A pattern is fastened on the upper side of the timber, with the edge of the form desired placed towards the cutter wheel. The formed edge of the pattern, as the carriage moves along, is pressed against a permanent guide by a weighted slide having a roller on that end of it which presses against the pattern. The piece of timber is protected from the cutters on the ascending side by a guard piece.

The claim is to the "arrangement by which a timber to be hewed is presented to, and guided along before, the cutters, in such manner as that the cutters act upon and hew the side of the timber according to a board or edge pattern, in conformity with any desirable curve or curves given to the edge of the pattern, as above described, or in any manner analogous thereto."

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37. For a *Machine for Planing and Forming Ivory Comb Plates;* Julius Pratt, Fermer Bush, Aaron Pratt, and Zena K. Murdock, of Meriden, Connecticut, George Read, Alphus Starkey, George Spencer, and John C. Rogers, of Saybrook, Connecticut, Assignees of William M. Fowler, North Branford, New Haven county, Connecticut, October 23.

This machine consists of an annular plate, with teeth on the inner periphery thereof, attached to the edge of a hollow cylinder, connected with a shaft by a funnel shaped casing. The plates of ivory previously prepared in the rough, are presented by means of a pair of feed rollers, curved longitudinally to correspond with the curve of the cutter, ring, or plate. Two spring guides of the proper curvature

are placed in front of the feed rollers to insure the presentation of the plates in a proper manner to the rotating cutters.

Claim.—"I do not claim as my invention a circular cutter with teeth on the inner edge of the circle merely, nor do I claim merely the mode of feeding by rollers, but I do claim as my invention the application of a circular cutter having a diameter calculated to give the proper curve for planing and fashioning comb plates, in combination with the mode of feeding, or bringing plates to the operation of the cutter, substantially in the manner as above described."

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38. For an improvement in the *Rotary Temple for Looms;* George Draper, Palmer, Hampden county, Massachusetts, October 28.

The patentee says.—"The main difficulty with the rotary temple now in use, consists in the construction of the wheel which is provided with only one set, or row, of oblique teeth, as by this arrangement the teeth must necessarily run constantly on the same thread, which has a tendency, in weaving thin fabrics, to crowd the threads too much to the selvage of the cloth, and by so doing, leave an open track where the teeth have passed."

The improvement claimed is for the employment of two rows of teeth instead of one, the teeth in one row being opposite to the spaces between the teeth in the other row.

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39. For an improvement in the *Machine for Cleaning Wool from Burs, and Ginning Cotton;* Milton D. Whipple, East Douglass, Worcester county, Massachusetts, October 28.

The wool or cotton is fed into the machine by an endless apron, and feed rollers, it is then taken by the toothed cylinder and carried to a doffing cylinder which has a vibratory motion. This doffing cylinder has upon it one or two steel plates running its whole length, with teeth on one or both edges, about a tenth of an inch apart; they are brought to an edge from the under side, and they are still further raised from the surface of the cylinder by placing strips of paper or pastboard under them. When the wool or cotton is taken from the toothed roller by the teeth on this vibrating cylinder, or doffer, it is stripped of the burs, or seeds, by a toothed plate, similar to those on the cylinder, attached to a guard plate above the cylinder.

The claim is to the "manner of applying and using the vibrating doffer, with its comb plates, constructed and operating as herein described, in combination with the toothed guard plate, as described; and this I claim whether the respective parts be formed exactly as herein represented, or in any other which is substantially the same, producing a like result by analogous means."

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40. For an improvement in the *Machine for Cutting Shingles;* Miles R. Payne, Andersontown, Madison county, Louisiana, October 30.

This patent is for an improvement on such machines as cut the shingles from a bolt by means of a knife, or knives, attached to a gate

which slides horizontally, and consists in the employment of two sliding dogs which hold the bolt whilst the knife, or knives, is cutting. These dogs are held against the bolt by means of weights, and they are pushed back by a cam piece on each side of the sliding gate.

The claim is confined to the sliding dogs in combination with the cams on the side of the gate.

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41. For an improvement in *Gaiter Boots;* John H. Duport and Theodore Hyatt, city of New York, October 30.

This improvement consists in a peculiar mode of making the spring gores employed in gaiter boots instead of lacings. These spring gores may be made of the same material with the boot, the gore being stitched, and shirred, so as to receive strips of India rubber, which render the gore elastic throughout. The strips of India rubber being attached at their ends, and operating like the wire springs of suspenders, &c.

After disclaiming the mere making of boots with spring gores, and with India rubber springs having shirred coverings, the patentees limit their claim to "gaiter boots made elastic by being constructed with an elastic gore, or gores, made from the combination of shirred materials and India rubber springs, substantially as described."

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42. For a *Machine for Cutting Cork;* Charles R. Macy, Hyde Park, New York, October 31.

The pieces of cork, called blocks, cut into proper lengths, are held between two revolving spindles which grip them, and as they revolve, the cork is cut round by a revolving cutter wheel, the arbor of which is horizontal and has its bearings in a sliding frame. This frame rests upon two cams, on a shaft parallel to, and under the shaft of the cutter wheel, the cams being of such form as that at the commencement of each operation the frame and knife will be lifted up, and cause the edge of the cutter wheel to approach the piece of cork to be cut, and when the cork has been cut, the frame and cutter wheel are let down to allow the revolving gripes to receive another block. The edge of the cutter wheel is kept sharp, during the operation, by means of two rotary disks, one acting on each face. The faces of these disks are covered with leather, and emery, or any other substance which will give an edge. As the cutter wheel revolves, to cut the cork, every part of its edge is brought around to these grinding disks. The blocks are fed in through a box, from which they are taken by a jaw which slides forward and places them between the gripes of the revolving spindles.

The claim is to the "combination of the rotary cutter wheels with the sharpening rotary disks, one on each face of the rotary cutter for the purpose and in the manner described.

"Secondly, to the method of moving the rotary cutter wheel up and down at the commencement and end of every operation by means of

the sliding frame, acted upon by the cams, for the purpose and in the manner described.

"And thirdly, to the method of feeding the machine with the block by means of the slide and jaw in combination with the receiving box and spindles as herein described."

The attempts at cutting corks by machinery have been numerous, and have uniformly proved failures; not that corks have not been cut by machinery, but because they have not been so well cut as by hand, and because the preparing and assorting of the blocks to be cut by the machine have required a degree of care and attention which are not repaid by the result.

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43. For *Clearing Snow from Railroads;* Joseph H. Moore, Worcester, and Benjamin Woodworth, Boston, Massachusetts, October 31.

This snow clearer consists of a drum having plates attached thereto spirally, from the middle towards each end, forming right and left screws of any desired number of threads, the depth of which will depend upon the breadth of the plates. This drum is situated in front of, and receives motion from a locomotive engine, and as it revolves and travels forward, the spiral plates take the snow and discharge it on each side of the track.

The patentees say, "our invention consists of the cylinder, or drum, with its shaft as above described, with the spiral plates, or snow clearers, constructed and attached to the drum, with a crank, or gear, wheel for driving or propelling the machine, as described, in connexion with a railroad engine for the purpose described."

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44. For a *Process of Preparing Tallow for the Manufacture of Candles;* John Kirkman, New York city, October 31, antidated July 2, 1840.

This process is for preparing tallow for hard candles by separating the oil, or elaine, therefrom without pressing. The apparatus used consists of a cask, with a partition, or false bottom, pierced with small holes, and placed within a short distance of its bottom. Sufficient water is to be put into the cask to cover the false bottom; and the tallow, after it has been boiled and settled in the usual way, is poured into the vessel whilst hot; and after being kept therein, at a proper temperature, for about twenty-four hours, it begins to seed, or grain; a cock in the cask, below the false bottom, is then opened which allows the water and also the oil to run out, the tallow remaining above the false bottom. The tallow thus prepared, we are told by the patentee, will make hard candles possessing all the qualities of those made from pressed tallow.

The claim is to the "method of separating the oily part of the tallow by means of setting the mass of tallow over water as above described, and drawing off the water and oil from the bottom."

45. For a machine for *Separating Garlic from Wheat;* Jona F. Barrett, North Granville, Washington county, New York, October 31.

The patentee says—"The principle upon which my machine operates is that of pressure, and of the friction of the grains against each other. The two being combined in such a manner as to produce the crushing of the garlic, smut, white caps, and other foreign matter by their attrition against the grain, and not by being rubbed against any thing of the nature of graters, points, or other asperities, on the interior of the machine, in which the agitation is effected. The pressure may be made in various ways, as by a high column of grain contained in a cylinder, or shaft, above the agitators, and pressing upon that portion which is subjected to friction by the agitators, or the grain may be pressed upon by a revolving or a stationary plate resting upon its surface.

"The grain to be cleansed is fed into a cylindrical vessel, within which it is subjected to pressure under, and by means of, a revolving plate, or disk, of weight sufficient to cause the garlic and all other substances less hard than the grain itself to be crushed by their attrition against the grain which is kept in motion by means of projecting pieces, which I call agitators, affixed to the bottom of the cylindrical vessel, and to the under side of the revolving plate, or disk."

Claim.—"Having thus fully described the nature of my invention and shown the manner in which I carry the same into operation, what I claim as constituting my invention, and desire to secure by letters patent, is the acting upon the grain by compression and attrition combined with a force sufficient to crush the garlic and other foreign matter, without breaking the grain itself, the same being effected in the manner herein set forth; that is to say by making pressure upon the grain subjected to attrition, either by means of a plate constructed as herein described, and revolving above it, and carrying agitators which co-operate with fixed agitators, as set forth; or by making the pressure by means of a column of the grain of sufficient height to effect the purpose, when combined with its agitation, by means of revolving and fixed agitators, arranged and operating substantially as set forth."

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46. For a method of *Protecting Trees from Canker Worms;* Daniel Newhall, Lynn, Essex county, Massachusetts, October 31.

This patent is for an improvement on the mode now in use of destroying the grub, and which consists of a trough placed around the tree, and containing oil, or other liquid, which is deleterious to the grub. The improvement is in placing a box over the trough, the edges of which extend below it, to prevent the dust and leaves from settling in the oil, or other liquid, and the wind from blowing it out. One or two of the sides of this box are hinged so as to give admission at the trough.

The claim is to the addition of "a roof or casing constructed as

described, in combination with a metallic trough for oil or other liquid suited to the object."

This seems to be a small affair for a patent; the placing of a lid, cover, or roof, to a trough, partakes about as little of substantial invention as could well be, to claim the sanction of the seal of the patent office.

Specifications of American Patents.

Specification of a Patent for an Improvement in the Manufacturing of Cloths of Wool, or Wool and Silk. Granted to Reuben Daniels, *Woodstock, Windsor county, Vermont, October 8th,* 1840.

To all to whom it may concern: Be it known that I, Reuben Daniels, of Woodstock, Windsor county, Vermont, have invented an improvement in the manufacturing of cloths of various kinds including those in which wool is the only material employed, and those into the manufacturing of which wool enters as an essential part thereof, and I do hereby declare that the following is a full and exact description of my new manufacture.

The improvement consists in the remanufacture of wool into cloths of various kinds, such as broad cloths, kerseymeres, sattinets, and others of a similar character, and into cloths in which the warp consists of cotton, silk, or other material, and the filling in whole or in part, of wool; or of cloths in which the cotton, silk and wool are mixed together, and are carded and spun in their combined state; all of which I have successfully essayed. The wool so remanufactured I obtain by taking worn out woolen goods of various kinds, and also worn out silks, and reducing them to their original state by means of machinery which I have invented for that purpose (and for which I have made application for letters patent, simultaneously with the present application) or reduced by means of any other machinery which will produce said fibres of wool in a state fit for remanufacturing into yarn and cloth.

I sometimes take such restored wool, and card, spin, and weave it, alone, or I mix it with fresh wool in proportion of, at least, one-sixth part of the restored wool to five-sixths of the fresh wool, and I, in either case, thereby obtain yarn or cloth equal in all respects to that which can be obtained from either fresh, or new, wool of the same degree of fineness, a result not heretofore obtained, and by which I am enabled to produce such cloth, and sell it at a price considerably lower than that of cloth consisting entirely of fresh, or new, wool; as it is a fact which I have established by full experience that the reproduced fibres of wool may be obtained from the worn out woolen goods, pound for pound, at a very trifling cost.

What I claim as my invention, or discovery, and desire to secure by letters, is the employment of wool and of silk obtained by the re-

ducing into the fibrous state of worn out woolen or silk goods, so as to produce new fabrics, by the operations of spinning and weaving, equal in all respects to those obtained from new, or fresh wool, said reproduced fibre to be used either alone or in proportion to that of the fresh wool of not less than one-sixth part.

REUBEN DANIELS.

English Patents.

Specification of a Patent granted to HENRY ELKINGTON, *of Birmingham, in the county of Warwick, for his invention of Improvements in Covering, or Coating, of Certain Metals with Platina; and also Improvements in Gilding Certain Metals, and in Apparatus used in such Processes.*—Sealed 17th February, 1837.

These improvements apply to the coating of metals with platina and gold, which is a new mode of gilding, intended to supersede the old practice of employing an amalgam of mercury and gold.

Platina, in the first instance, is to be dissolved in nitromuriatic acid. About ten ounces of nitric acid, and the same of muriatic acid, is required to dissolve one ounce of platina; and the combined acids must be kept at a gentle heat until the dissolution has been completely effected.

When this has been done, the liquid is to be evaporated to about half its quantity, and then three quarts of water added to it, with three ounces of bi-carbonate of soda, which is to be boiled until the soda is dissolved, and then one pound of bi-carbonate of potash added; after which the whole must be boiled together for half an hour.

A slip of brass, or copper, put into this solution, will experience little or no change in its appearance; but if a solution of gold be added to it, in proportions of from one to five pennyweights of gold to the quantity of the solution, then the gold and platina will attach themselves to the metal.

While this process is going on, the solution must be kept boiling, and the effect will be in proportion to the quantity of gold employed, and the continuance of the boiling. At first, the surface of the metal under operation, will appear of a bronze colour, but it will ultimately assume that of fine gold.

Another mode of gilding proposed, is by first coating the articles with platina in a metallic state, and then submitting them to immersion and boiling in the solution of gold. The effect will be the same nearly; the process only differing.

Under this head of the invention, the patentee claims the exclusive use of carbonate of potash, or soda, in solution with platina and gold, for the purpose of gilding the surfaces of metals.

An inferior mode of gilding is also mentioned, which is effected by boiling the articles in a solution of mercury, potash and gold; but this is only employed for articles of a less costly quality, and is substitut-

ed for an amalgam of mercury and gold, upon which it is an improvement, as a more ready, cheaper, and better mode of gilding.

The articles of jewelry thus gilt, may be coloured and lacquered, in the old way; that is, by the known processes, in which the patentee does not claim any novelty.

In order to preserve the platina, and gold, which may remain in solution after the gilding operation is done, it is proposed to evaporate the solution in a close vessel, by means of a vacuum, produced by an air pump. The particular form of this vessel, however, is unimportant, so long as it will effect the object proposed; which is to allow the metallic residuum to be preserved, and made capable of being employed for a future operation of gilding.

London Journal of Arts and Sciences, May, 1841.

Specification of a Patent granted to Bernard Aube, *of the city of London, for Improvements in the Preparation of Wool for the Manufacture of Woolen and other Stuffs, and in the process of Obtaining the Materials to be used for that purpose.*—[Sealed May 7th, 1840.]

In preparing wool for the manufacture of woolen and other stuffs, it is well know that large quantities of oil are used to facilitate the working of the wool in the preparatory processes through which it passes, and the descriptions of oil used are expensive. Now the objects of my invention are to use oleic acid, which is comparatively a cheap article of manufacture, possessing properties peculiarly adapted to the preparatory processes through which wool passes; and also by washing wool containing oleic acid in an alkaline solution, there will be a saponaceous product obtained applicable to the fulling of woolen cloth, which I prefer to oleic acid, following the ordinary processes by which the oleic acid would be washed away, in like manner to what is generally the case when washing and pressing out the oils used, and as heretofore practised.

I would here remark, that oleic acid is a fluid well known, and is the fluid product or acid obtained from fatty matters, when the two acids composing fatty matters are separated, and such separation is now largely practised by persons engaged iu the manufacture of what are called stearine candles, and the various processes for separating the acids are well known, and form no part of my invention; and oleic acid may be purchased in large quantities, particularly from manufacturers of stearine candles. And in carrying out my invention, in place of using oils, I use such fatty acid called oleic, or tallow oil, and using the same intimately with the wool in a similar manner to that usually resorted to when employing the oils now used; and the workmen will judge by the working of the wool whether he has applied sufficient oleic acid or not, in the manner as he now judges whether he has applied sufficient oil, by the manner in which the wool under operation works, because it is well known that different wools require different quantities of oil, and therefore no exact quan-

tities can be given, and different workmen use more or less oil in working the same descriptions of wool. All that will therefore be necessary to state is, that in using oleic acid for the oils now employed, the workmen will judge by the freedom with which he can work the wool, and will use more or less of the oleic acid. When removing the oleic acid from the wool or fabrics made therefrom, it may be accomplished by the same means as heretofore practiced when the oils now employed have been used; but I prefer that the water used should have an alkali dissolved therein, so as to convert the oleic acid into a saponaceous product, which will be found particularly useful for fulling woolen cloths in place of soap; and for this purpose I dissolve about one half by weight of soda of commerce (which is the alkali I prefer, but I do not confine myself to that alkali,) of the weight of the oleic acid known to have been used in preparing the quantity of wool which is now to be treated, and such quantity of alkali is to be dissolved in a quantity of water about twice the weight of the wool to be cleansed. Although I am thus particular in giving quantities, I do not confine myself thereto, as they may be varied, but the quantities stated are those which I have used. By thus using an alkaline solution as the material for washing out the oleic acid from the wool, in addition to getting rid of the oleic acid, I also, as above stated, obtain a product very suitable for fulling woolen cloths.

Having thus described the nature of my invention, I would have it understood that what I claim is, first, the mode of preparing wool by the use of oleic acid in such processes.

And secondly, I claim the mode of preparing wool by the use of oleic acid, when combined with the removing it therefrom by means of an alkaline process, as described.

Repertory of Patent Inventions, July, 1841.

Specification of a Patent granted to THOMAS MACGAURAN, *of the County of Middlesex, for Improvements in the Manufacture of Paper from a Material not hitherto so employed.*—[Sealed August 26th, 1840.]

The invention consists in manufacturing paper from the hop-bine, which may be used as a substitute for the pulp of linen or other rags, or it may be used mixed with linen rags, or any other suitable material, if desired.

I will now describe the mode of preparing the bine, in order to render it suitable for the manufacture of fine paper. I take the bine after the hops are removed, and after bruising the stalk by passing it through rollers, or by any of the ordinary means (used for bruising hemp and other fibrous plants,) and cut it into small pieces of one or two inches long. I then place these pieces to soak in rain or river water, where they should be allowed to remain immersed in water for about twenty-four hours; they are then to be well washed, without breaking the pieces, in the ordinary washing engine (that being well known to paper makers, I have not thought it necessary to des-

cribe it,) this washing should continue until the water passes away perfectly clear; during this part of the process the roller should not touch the plate. When it is well washed I stop the water from passing through, and let down the roller on to the plate, and beat the bine until no splints or white chips appear. It is then to be taken to a press and to be subjected to pressure until nearly dry. It is then to be put into a cistern, which I prefer should be of stone, or lead, containing chloride of lime; and I use about 10 lbs. of chloride of lime to 100 lbs. of bine, in which it should be immersed for twenty-four hours. It is afterwards cleansed from the chloride of lime by a stream of water passing through the cistern. It is then to be subjected to the operation of an ordinary beating engine. The rougher the surface of the blade and plate of such engine is, the better. It is then triturated and beaten into an impalpable pulp. I take this pulp and submit it to the same process as just described. It will then be in a fit state to be manufactured into fine paper. In making coarse paper the process is the same as above described, with the omission of that part of it which applies to the reducing it to an impalpable pulp, that not being necessary. The paper may be bleached by any of the ordinary well known means.

Having thus described the nature of the invention and the manner of performing the same, I would remark that I do not confine myself to the mode herein described of preparing the bine, though I believe it to be the best for the purpose; but what I claim as this invention is the manufacturing paper from the hop-bine, either by itself, as a substitute for linen or other rags, or it may be mixed with them, or other suitable material, for the purpose of making paper. Ibid.

Progress of Practical & Theoretical Mechanics & Chemistry.

Upon the Application and Use of Auxiliary Steam Power, for the purpose of shortening the time occupied by Sailing Ships, upon distant voyages. By Samuel Seaward, M. Inst. C. E.

But few years have elapsed since the possibility of propelling vessels by the power of steam was treated as a chimera; and although the practicability of its application for short voyages has been successfully demonstrated, by the numerous vessels plying between this country and the continent, it is but of very recent date that its employment for long sea voyages has been adopted. The weight of the powerful machinery and the fuel, and the consequent loss of space for cargo, together with many other circumstances attendant on the present construction of steam vessels, induced the author (who received the education of a seaman, and has since had extensive practice as an engineer) to believe that a more efficient mode of employing steam power, for long sea voyages, might be adopted.

Notwithstanding the great improvements which have taken place in the construction of steam vessels, and their machinery, it would

tities can be given, and different workmen use more or less oil in working the same descriptions of wool. All that will therefore be necessary to state is, that in using oleic acid for the oils now employed, the workmen will judge by the freedom with which he can work the wool, and will use more or less of the oleic acid. When removing the oleic acid from the wool or fabrics made therefrom, it may be accomplished by the same means as heretofore practiced when the oils now employed have been used; but I prefer that the water used should have an alkali dissolved therein, so as to convert the oleic acid into a saponaceous product, which will be found particularly useful for fulling woolen cloths in place of soap; and for this purpose I dissolve about one half by weight of soda of commerce (which is the alkali I prefer, but I do not confine myself to that alkali,) of the weight of the oleic acid known to have been used in preparing the quantity of wool which is now to be treated, and such quantity of alkali is to be dissolved in a quantity of water about twice the weight of the wool to be cleansed. Although I am thus particular in giving quantities, I do not confine myself thereto, as they may be varied, but the quantities stated are those which I have used. By thus using an alkaline solution as the material for washing out the oleic acid from the wool, in addition to getting rid of the oleic acid, I also, as above stated, obtain a product very suitable for fulling woolen cloths.

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Progress of Practical & Theoretical Mechanics & Chemistry.

Upon the Application and Use of Auxiliary Steam Power, for the purpose of shortening the time occupied by Sailing Ships, upon distant voyages. By Samuel Seaward, M. Inst. C. E.

But few years have elapsed since the possibility of propelling vessels by the power of steam was treated as a chimera; and although the practicability of its application for short voyages has been successfully demonstrated, by the numerous vessels plying between this country and the continent, it is but of very recent date that its employment for long sea voyages has been adopted. The weight of the powerful machinery and the fuel, and the consequent loss of space for cargo, together with many other circumstances attendant on the present construction of steam vessels, induced the author (who received the education of a seaman, and has since had extensive practice as an engineer) to believe that a more efficient mode of employing steam power, for long sea voyages, might be adopted.

Notwithstanding the great improvements which have taken place in the construction of steam vessels, and their machinery, it would

appear that the duration of the voyage ought not to exceed twenty days, after which time a fresh supply of fuel becomes necessary; hence, steam has rarely been adopted for very long voyages. The reason of this limit to the duration of the voyage of a steam vessel, as at present equipped, is that an increase of power does not produce a corresponding increase of speed, while the weight of machinery increases in proportion to the power employed, and in some cases exceeds it; for instance, small engines, with the water in the boilers, generally weigh about one ton per horse power, while in some large engines the ratio is nearly twenty-five cwt. per horse power.

A quadruple increase of power will not produce double the original velocity in a steam ship, although, in theory, such is assumed to be the case; for, as the weight is more than double, the immersed sectional area becomes greater, and a still further increase of power is necessary. It has been shown by experience, that if a vessel, with a given power, is propelled through the water at the rate of eight miles per hour, her speed cannot be doubled, even though the power be multiplied twelve times, and the entire hold of the vessel be occupied as an engine room.

The weight of fuel is also in direct proportion to the size of the engines; so that taking for example, two vessels of two hundred and of four hundred horses power respectively—that of the higher power will have to carry nearly double the weight, both of fuel and of engines, and it is still questionable whether the increased force will propel the one ship more than one and a half miles per hour faster than the other.

The space occupied by the engines and fuel, in the most valuable part of the ship, is also an important consideration: neither the "President" nor "British Queen" steamer, although of two thousand tons measurement, is capable of carrying more than five hundred tons of cargo, when the fuel is on board.

The author then examines the question of employing too much power in a steam vessel, and refers to the "Liverpool," as an instance that such may be the fact. It appears that with the original dimensions of thirty feet ten inches beam, and engine power of four hundred and fifty horses, being a proportion of power to tonnage of about one to two, and one-fourth the vessel was immersed four feet beyond the calculated water line, and a decided failure was the natural consequence; but when the breadth of beam was increased to thirty-seven feet, augmenting the capacity of four hundred tons, and giving the proportion of one horse power to three and three-fourths tons burthen, the performance of the engine and the speed of the vessel were both materially improved.

The "Gem," Gravesend steamer, one hundred and forty-five feet long, by nineteen feet beam, had two engines of fifty horses power each; the speed was insufficient, being only twelve and a half miles through the water; but when the same engines were placed in the "Ruby," which was one hundred and fifty feet long, and nineteen feet nine inches beam, the velocity of the latter vessel was thirteen and a half miles per hour. A pair of engines, of forty-five horses

power each, were then placed in the "Gem," without altering the vessel, and in consequence of the diminished weight and draught of water, her speed then nearly equalled that of the "Ruby."

The author does not condemn the application of considerable power for vessels, providing it can be employed without materially increasing the weight and the area of the immersed midship section. It appears that the length of a steam voyage, to be profitable, is at present limited to twenty days for the largest class of steamers; that we have about thirty others which can approach twelve days, while the majority cannot employ steam beyond eight days successively, without a fresh supply of fuel. It is evident, therefore, that more efficient means must be adopted for the general wants of commerce in our extended intercourse with the East and West Indies, the Pacific, Mexico, Brazil, Australia, and all the distant colonies, which now demand rapid communication with England.

The author refers to a pamplet, published by him in 1827, entitled "Observations on the possibility of successfully employing Steam Power in Navigating Ships between this country and the East Indies by the Cape of Good Hope." He therein proposed that large square-rigged ships, of fifteen hundred to eighteen hundred tons measurement, should be fully equipped and constructed so as to sail ten or eleven miles per hour with a fair wind; that they should carry engines of small power, to assist the sails in light winds,—propel them at a moderate speed during calms,—work into and out of harbour, &c.,—and thus shorten those portions of the voyages wherein so much time was usually lost.

To all well built good sailing vessels, of four hundred tons and upwards, "auxiliary steam" is applicable. A steam engine of the necessary power, can, without inconvenience, be placed in such vessels, either on or between decks, so as to propel a ship at the rate of four to five nautical miles per hour in a calm, and for this speed a proportion of one horse power to twenty-five tons is amply sufficient. The practicability of applying this system to East Indiamen and other similar vessels, is then examined at length, and it is shewn that the ordinary speed of these ships under sail, is, before the wind, eleven to twelve miles per hour, and in a gale thirteen to fourteen miles per hour, which is greater by two or three miles per hour than that of any ordinary steam vessel when under sail, on account of the latter being impeded by the wheels trailing in the water, and the slightness of their masts, spars, and rigging. The auxiliary steam power might, therefore, be efficiently applied, either by using it alone, or in conjunction with the sails, so as to keep up a uniform speed, by which a great saving of time could be effected in a long voyage.

The conditions of sailing and steaming voyages to India, with the influence of the trade winds, are then examined, and the author proceeds to detail the experiments made by him, on board the "Vernon" Indiaman, which was the first sailing vessel that actually made a voyage out and home with "auxiliary steam."

The "Vernon," built in 1839, by the owner, Mr. Green, was one thousand tons burthen; the sailing speed was about twelve to thirteen

miles per hour in a fresh gale, and being from her frigate build well calculated for the experiment, it was determined to equip her with a condensing engine of thirty horses power, placed midships on the main deck, between the fore and main hatchways; the space occupied being twenty-four feet long by ten wide. The weight of the machinery was twenty-five tons, and it was so arranged that the motion was communicated direct from the piston cross-head, by two side rods, to the crank on the paddle shaft, placed immediately behind the lower end of the steam cylinder, which was horizontal. The wheels were fourteen feet diameter, projecting five feet, and were so constructed that the float boards could be raised to suit the draught of water of the ship; or they could be taken entirely away, if necessary, leaving the shafts projecting only eighteen inches beyond the sides. Under ordinary circumstances they were disconnected from the engine by a simple contrivance, consisting of a movable head, attached to the crank on the paddle shaft, by turning which, one quarter of a circle, the crank pin was liberated, and the wheels turned freely round. The "Vernon," thus equipped, having on board nine hundred tons of cargo, and sixty tons of coal, drew seventeen feet of water. In the first trial the speed of the vessel, under steam alone, was five and three-quarters nautical miles per hour, demonstrating how small a power is necessary for a moderate speed. She then started for Calcutta, and though the piston rod broke three times during the voyage, owing to a defect in one of the paddle shaft bearings, the passage was satisfactory. The details are given minutely, as are also those of the homeward voyage, which was performed from Calcutta to London in eighty-eight days, to which must be added seven days for necessary delay at the Cape, making a total of ninety-five days, which is the shortest passage on record. Great credit is given to Captain Denny for the judgment with which he used the auxiliary steam power, and the course taken by him, by which he was enabled to overcome the difficulties incidental to a first trial of so important a system. The success of the "Vernon," induced the immediate application of engine power to the "Earl Hardwick" Indiaman, and both these vessels are now on their voyage out to Calcutta.

For the purpose of demonstating the ratio of power to velocity, a Table was also given showing the velocities of ships of different tonnage, having steam power of various ratios, deduced from upwards of one hundred experiments on large steam vessels.

It was shown, that an engine of thirty horses power would propel a ship of twelve hundred tons burthen, at the rate of four knots per hour, while three hundred horses power would only propel the same ship at the rate of ten and five-ninths knots per hour. Hence, ten times the power would only produce about two and a half times the speed.

The principal points in the paper were more fully dwelt upon, and, in answer to questions from some of the members, Mr. Seaward remarked, that no steamer in England had ever been propelled at more than fifteen geographical miles per hour, through still water.

In some of the Government mail packets, the engines and coals were the full cargo of the vessel. The table did not apply to vessels

overladen with power, for as the weight increased in the ratio of the power, so the immersed sectional area was augmented, and the lines of the vessel, which might be well calculated for speed when at a proper draught, became lines of retardation, and the engines did not work up to their proper speed, owing to the depth to which the paddle floats were immersed. For instance:—The wheels of the "British Queen" have been plunged between six and seven feet, instead of four feet, which was the calculated dip; the engines at the same time diminishing their speed so much as to reduce the effective power from five hundred horses to nearly three hundred horses.

The only advantageous way in which great power could be applied, would be by contriving to prevent the increase in the weight of the machinery and fuel, and those engineers would be most successful who could so apply the materials of construction, as to ensure strength without the usual corresponding increase of weight.

Mr. George Mills, from his experience as a ship-builder, at Glasgow, was enabled to confirm all that Mr. Seaward had advanced. On the Clyde, the employment of an excess of power in steam vessels had been carried to the greatest extent, without producing corresponding advantages, either for speed, or in a commercial point of view. It would appear that the same error had, to a certain degree, been committed on the Thames, but less than on the Clyde; for on the latter river there were vessels with nearly double the power, in proportion to the size, as compared with any vessel on the former river. He believed that on the Thames no vessel had so much as one horse power for each register ton, whereas on the Clyde, there were steamers of seventy to eighty tons register, having single engines, with cylinders of fifty-four inches diameter, which was more than one hundred horses power. It would appear that this application of extra power had only obtained a very moderate speed, while the great first outlay, with the commensurate current expenses, had reduced the commercial profit to the lowest point,—of this the proprietors alone could give any account; but as to the speed attained, he had seen three steamers of identical tonnage leave the Broomielaw at the same time, their engines being respectively of one hundred and ten, eighty, and sixty horses power; yet their speed was in the inverse ratio of their power: the vessel with the smallest engine arrived at Greenock first, the greater power second, and the greatest last. These remarks were only applicable to river boats. With regard to sea-going vessels, the system had not been carried to so serious an extent, yet with them the average proportion was about one horse power to two register tons, and some few reached as high as one horse to one and one-eighth of a ton.

As an example of an augmentation of power producing an opposite result from that which was intended, Mr. Mills mentioned two vessels called the "Tartar" and the "Rover," built by him and his (then) partner, Mr. Charles Wood. They were each of about two hundred and twenty tons register, built from the same draught, and in every respect as similar as possible—except that the engines, which were by the same maker, were respectively of one hundred and seventy,

and one hundred and thirty horses power; yet whenever they worked together, the one with the smaller power proved herself the faster vessel, either in a calm, with the wind, or even against it. The "Achilles," Liverpool steamer, which lately had an addition of thirty feet to her length, and eighteen inches to her breadth, augmenting the tonnage about one-fifth, had improved her speed upwards of one mile per hour, although she carried a much heavier cargo than before.

He had built a vessel of five hundred and sixty tons register, with engines of one hundred and thirty horses power on board—a proportion of power to tonnage of one to four; the stowage for cargo was ample; the accommodation for passengers excellent. She drew little water, and her speed was much greater than vessels of double her power. Yet in spite of all this, the vessel could not find a purchaser, because the power was not nominally large.

It would be asked—why, with these and so many similar instances, such a system was continued? It was not likely that the engineers would complain of having orders for large engines; and there were certain dimensions prescribed for the vessel, to which the ship-builder was under the necessity of conforming.

The chief cause of mischief, however, was the fiat of the public. It was believed that a great power would remedy want of speed and all other evils, and it was found indispensable for ensuring the confidence of travellers. Hence, the shipowners, who depend upon the public for support, were obliged, against the conviction of their experience, to keep up the errors occasioned by ignorance.

The President observed, that the condemnation of large power should not be carried too far, as experience alone had produced the increase of weight, strength, and power of the present engines, compared with those of the early steamers which were built, instancing the Halifax Packets (Cunard's,) which with their great power in proportion to tonnage, had performed their duties satisfactorily.

Mr. Mills explained that the Halifax Packets were built for the especial purpose of carrying the mails only, to perform the voyage in a given time,—about twelve days. The engines were built by Mr. Robert Napier, after the model of those of the "Great Western," which used their steam expansively; similar provisions had been made in the Halifax Packets, but the expansion valves were seldom used.

Mr. Field agreed with the principal part of Mr. Seaward's paper, but he would prevent an erroneous conception of the term *overpowering* a steamer. A vessel could not have too much power, provided that power could be advantageously applied, without causing too deep an immersion. A good result could be produced only by keeping a proper proportion between the machinery, the vessel, and the paddle wheels, and immersing the hull of the steamer only as deep as the true lines of draught.

Mr. Vignoles observed, that in this country the reputation of engineers depended upon the commercial success of the works they engaged in. An erroneous public opinion might have influence at present; but if the engineer and ship builder would determine to break these trammels, and produce such vessels as should force conviction upon

the public mind by the speed attained, and show the proprietors the consequent commercial advantage, the present system would soon be abandoned.

Mr. Parkes eulogized Mr. Seaward's candour in describing the errors in the first construction of the engine on board the Vernon; more was frequently to be learned from failures than from successful efforts, and no communications to the Institution would be so useful as those which gave accounts of defective design or construction, with the details of the methods adopted for remedying the defects. He directed attention to the performances of the "Great Western" steam ship, which at least equalled those of the Halifax Packets, without the disadvantages of being unable to carry cargo, or of shipping so much sea, when the weather was foul. The important feature of economy of fuel on board the "Great Western" might be in part attributed to the use of steam expansively. It was very desirable that the Institution should possess very full drawings and a description of the "Great Western," so as to be enabled to compare them with those of the Halifax Packets, which had been promised by Mr. George Mills. He would impress upon manufacturers of marine engines the necessity of adopting a correct and uniform nomenclature of the power placed on board steam vessels. The nominal selling power did not accord with any calculation.

Mr. Field believed the Table of Velocities calculated by Mr. Seaward to be very nearly accurate. The speed of the "Great Western," when loaded to her proper draught, had been as high as $13\frac{8}{10}$th miles through still water. There was an error in the alleged speed of Cunard's vessels; they reached Halifax in ten days, Boston in three more, and then had still one day's voyage to New York. The average duration of the voyages of the "Great Western," was about fourteen days and a half. If two hundred tons were deducted from the tonnage of the "Great Western" for cargo and the accommodation for the passengers, she would then be similar to the Halifax Packets. The engines of the "Great Western" were nominally estimated at four hundred horses power, and the average consumption of fuel was twenty-six tons every twenty-four hours.

During the discussion, Mr. Cubitt had calculated the following Table, showing the rates of velocity which would be attained by substituting engine power, with its consequent weight of one ton per horse power, for cargo, so as to preserve the draught of water the same in all cases.

Mr Seaward remarked, that his Table of power and velocities was corroborated by Mr. Cubitt's—the practical results verified both. The great difference between the "Great Western" and the Halifax Packets, consisted in the better adaptation of weight and power to tonnage, and the more economical consumption of fuel of the former over the latter—the one carrying cargo and passengers, the other only the engines and fuel, yet the "Great Western" traveled farther with the same quantity of fuel.

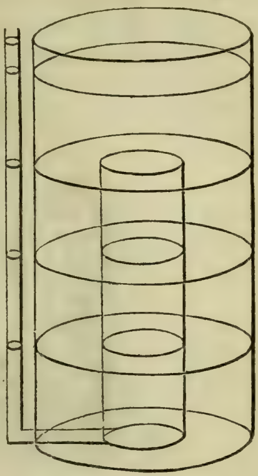
Table showing the power required to obtain various rates of speed in a steam vessel, where the total weight of cargo and engines remains in all cases the same, and in which, with a power of 30 *horses, a speed of five miles per hour is obtained; and the total weight carried being in all cases* 1000 *tons, and the engines weighing one ton per horse power.*

Weight of Cargo.	Weight and Power in Tons and Horse Power.	Relative Speed.	Speed in Miles per hour.
970	30	$5\sqrt[3]{1}$	5.
940	60	$5\sqrt[3]{2}$	6.299
910	90	$5\sqrt[3]{3}$	7.211
880	120	$5\sqrt[3]{4}$	7.937
850	150	$5\sqrt[3]{5}$	8.549
820	180	$5\sqrt[3]{6}$	9.085
790	210	$5\sqrt[3]{7}$	9.564
760	240	$5\sqrt[3]{8}$	10.
730	270	$5\sqrt[3]{9}$	10.4
700	300	$5\sqrt[3]{10}$	10.772
670	330	$5\sqrt[3]{11}$	11.119
640	360	$5\sqrt[3]{12}$	11.487
610	390	$5\sqrt[3]{13}$	11.756
580	420	$5\sqrt[3]{14}$	12.050
550	450	$5\sqrt[3]{15}$	12.331
520	480	$5\sqrt[3]{16}$	12.599
490	510	$5\sqrt[3]{17}$	12.856
460	540	$5\sqrt[3]{18}$	13.103
430	570	$5\sqrt[3]{19}$	13.34
400	600	$5\sqrt[3]{20}$	13.572
370	630	$5\sqrt[3]{21}$	13.794
340	660	$5\sqrt[3]{22}$	14.01
310	690	$5\sqrt[3]{23}$	14.219
280	720	$5\sqrt[3]{24}$	14.422
250	750	$5\sqrt[3]{25}$	14.62
220	780	$5\sqrt[3]{26}$	14.812
190	810	$5\sqrt[3]{27}$	15.
160	840	$5\sqrt[3]{28}$	15.182
130	870	$5\sqrt[3]{29}$	15.3615
100	900	$5\sqrt[3]{30}$	15.535
70	930	$5\sqrt[3]{1}$	15.706
40	960	$5\sqrt[3]{32}$	15.854
10	990	$5\sqrt[3]{33}$	16.037

London Journal of Arts and Sciences, July, 1841.

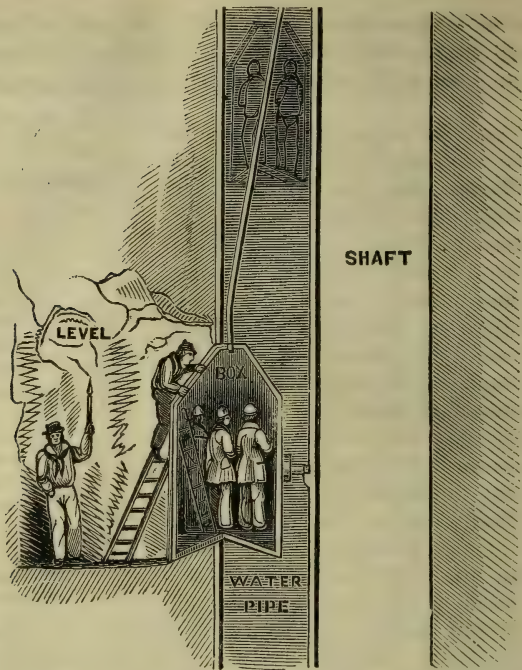
Simple Illustration of the Doctrine of Latent Heat. By Dr. Dalton.

The following simple illustration of the doctrine of latent heat by Dr. Dalton will enable those who are not familiar with the operations of heat to form a tolerably correct notion of the phenomenon in question:



The liquid and its vapour may be considered as two reservoirs of caloric, capable of holding different quantities of that fluid. Let the figure represent to us such an arrangement; the internal cylinder of smaller capacity, the external one of enlarged capacity surrounding and extending far above it, and a small open tube of glass, communicating freely at the bottom with the internal cylinder. Let us now conceive the water to be poured into the internal cylinder, the water will manifestly flow into the slender tube till it stand on the same level in the tube as in the cylinder. If any additional quantity be now poured into the internal cylinder, the rise of water in the slender glass tube will serve as an index of the quantity of added fluid; and when it is filled to the top, the fluid will stand at the height marked 212°, and will still be a correct index of the addition of fluid. But if more water be now added to it, it will not make its appearance in the slender tube, but will simply overflow from the internal cylinder over into that of enlarged capacity, so that while a large quantity is passing into the vessel and gradually filling it up to 212°, no additional rise takes place until the whole of the outer cylinder becomes filled to that point, after which any further addition will again become sensible, by a corresponding rise in the tube. This process is in precise analogy to the succession of circumstances in heating a liquid, and converting it into steam. The internal cylinder represents the liquid, the external one the vapour of greater capacity, and the slender glass tube at the side the thermometer placed in communication with them. When heat flows into the liquid, it passes equally into the thermometer; and each increment of the one produces an equal increment in the other, until the liquid reaches the limit of its capacity, when it suddenly begins to enlarge its bulk and take the form of steam; but the quantity of heat required to fill up this enlarged capacity is so great, as to require about 5½ times as much to fill it as was contained in the whole liquid before, so that all this time the thermometer is standing still, and it is not until the whole of the steam is thus supplied with 212° of caloric, that the thermometer will begin to show any further elevation; after which, any increment of heat thrown into the steam will make its appearance on the thermometer, and proceed as formerly, by simultaneous increments.

New Plan for Raising and Lowering Miners.



A cast-iron, or other, tube of sufficient strength, filled with water, is to be placed in the shaft, and extending from the bottom to the top of the mine; in this air-tight boxes are to be immersed. For ascending, of course, they must be a little lighter than the water, and, for descending, the admission of a small quantity of water will be sufficient, of course depending upon the velocity wished for. At whatever place it is required to stop, whether at the middle or at the bottom, a lock must be provided, into which these air-tight subaqueous miners' omnibuses may be conveyed; and, communication being cut off from the upright pipe, the miners may, on opening a door, disembark in safety. If it should be found that there was not sufficient air in the box for the ascent or descent, a flexible air-tube might be attached to it, which, by having a suitable weight to it, might travel along an inclined piece of ground near the mouth of the shaft. As there would always be some little loss of water in the opening and shutting of the locks when ascending, instead of admitting water from the main tube, before opening communication, the lock should be filled, from some small running in the mine at that level, and so save extra pumping. In these operations there would be no expensive machinery, no power to maintain—the opening and shutting of the locks would be the only things to attend to.

Carolus.

"An account of some experiments to determine the force necessary to punch holes through plates of wrought Iron and Copper." By Joseph Colthurst. Read before the Lond. Inst. Civil Engrs.

These experiments were performed with a cast-iron lever, 11 feet long, multiplying the strain ten times, with a screw adjustment at the head, and a counterpoise.

The sheets of iron and copper which were experimented upon were placed between two perforated steel plates, and the punch, the nipple of which was perfectly flat on the face, being inserted into a hole in the upper plate, was driven through by the pressure of the lever.

The average results of the several experiments which are given in a detailed tabular form, show that—

The power required to force a punch—

Inch diam.	Through an iron plate	Inch thick.	
0.50	ditto	0.08	is 6,025lbs.
0.50	ditto	0.17	is 11,950lbs.
0.50	ditto	0.24	is 17,100lbs.
	Through a copper		
0.50	plate.	0.08	is 3,983lbs.
0.50	ditto	0.17	is 7,883lbs.

Hence it is evident, that the force necessary to punch holes of different diameters through metals of various thicknesses, is directly as the diameter of the holes and the thickness of the metal.

A simple rule for determining the force required for punching, may thus be deduced.

Taking one inch diameter, and one inch in thickness, as the units of calculation, it is shown that 150,000 is the constant number for wrought iron plates, and 96,000 for copper plates.

Multiply the constant number by the given diameter in inches, and by the thickness in inches; the product is the pressure in pounds, which will be required to punch a hole of a given diameter, through a plate of a given thickness.

It was observed that duration of pressure lessened considerably the ultimate force necessary to punch through metal, and that the use of oil on the punch reduced the pressure about eight per cent.

Mining Journ.

New Shoe for Horses.

A Frenchman of the name of Jony, who is at present resident in Poland, has invented a new method of shoeing horses, for which the Emperor has awarded him 50,000 rubles, besides an exclusive patent. Jony covers the entire hoof with iron, and the base of his shoe, or as it is called, the sandal, is perfectly smooth. This method of his is being adopted in all parts of Russia. It requires neither nail nor screw; it is extremely cheap; and has the important characteristic of great lightness. Horses, whose hoofs have been destroyed by bad shoeing, are, by the use of these "hippo sandals," restored in a short time to their former state of efficiency, and may be used as soon as they are provided with them.

Lond. Mech. Mag. Feb. 1841.

Manufacture of Carbolein.

The manufacture of this new kind of fuel, invented by M. Weschinskoff, of St. Petersburgh (which we have before noticed,) is thus described in the *Moniteur Industriel*:—"It is composed of coal, or of any other combustible, pounded as fine as possible, and mixed with a sufficient quantity of animal or vegetable oil; this mixture is subjected to a strong pressure, in order to produce pieces as hard and solid as stone; from an equal weight this carbolein yields five times more heat than common coal of the best quality. The flame which it produces is very bright, and burns for a long time; this property will render it extremely valuable in foundries, in the manufacture of arms, and in glass works, &c. In short, it will be useful for all purposes where it is important to obtain quickly a hot and continuous fire. It appears from the results of its use on the steam-ship *Sirius*, that the paddle-wheels which made twelve revolutions in a minute with the best coal, made nineteen in a minute when carbolein was used. This new combustible appears then to be very useful, and deserves that further experiments should be made in order to ascertain the accuracy of the results, which are stated to have been arrived at in the experiments already made.

Mining Journ.

Meteorological Observations for October, 1841.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	46	64	29.90	30.00	NW.	Moderate.		Clear—do.
	2	46	56	30.14	.15	NE.	do.		Cloudy—do.
	3	44	42	29.86	29.86	E.	Brisk.	1.78	Rain—do.
	4	42	55	.86	.86	W.	Moderate.		Cloudy—clear.
	5	40	57	30.00	30.03	W.	do.		Clear—do.
☽	6	40	58	.03	.00	NW.	do.		Clear—do.
	7	42	58	.00	29.90	NW.	do.		Clear—do.
	8	53	59	29 80	.76	W.	do.	.07	Cloudy—rain.
	9	50	63	.76	.80	W.	Brisk.		Clear—flying clouds.
	10	44	60	30.00	30.04	W.	Moderate.		Clear—do.
	11	42	64	.04	29.96	SW.	do.		Fog—hazy.
	12	57	62	29.80	.75	SW.	do.	.57	Rain—cloudy.
⊗	13	49	57	.86	.90	NW.	do.		Clear—flying clouds.
	14	40	51	30.00	30.05	NW.	Brisk.		Clear—flying clouds.
	15	41	60	.00	29.85	W.	do.	.03	Clear—rain.
	16	50	54	29.90	.90	NW.	Moderate.		Cloudy—do.
	17	36	52	30.06	30.00	W.N.	Brisk.		Clear—do.
	18	35	50	.05	.10	W.	do.		Clear—do.
	19	34	50	.10	29.96	W.	Moderate.		Clear—cloudy.
	20	44	51	29.60	.47	SW.	Brisk.	.40	Rain—clear.
	21	44	52	.43	.43	W.	do.		Cloudy—do.
☾	22	41	49	.50	.50	W.	do.		Clear—cloudy.
	23	40	48	.70	.70	W.	Moderate.		Cloudy—do.
	24	39	48	.70	.74	W.	Brisk.		Partially cloudy—do.
	25	32	40	.95	30.05	W.	do.		Clear—flying clouds.
	26	28	49	.85	.00	W.	do.		Clear—do.
	27	38	55	30.06	.06	W.	Moderate.		Hazy—do.
	28	35	50	.30	.35	E.	do.		Hazy—do.
	29	46	59	.33	.30	SW.	do.		Cloudy—partially cloudy.
	30	52	62	.26	.26	W.S.	Calm.		Cloudy—clear.
☉	31	49	63	.27	.30	SW.	do.		Fog—lightly cloudy.
	Mean	42.55	54.77	29.94	29.94			2.85	

	Thermometer.		Barometer.	
Maximum height during the month,	64 00	on the 1st and 11th.	30.35	on the 28th.
Minimum " "	28.00	" 26th.	29.43	" 21st.
Mean	48.66		29.94	

INDEX.

AMERICAN PATENTS, LIST OF, WITH EDITOR'S REMARKS, &c.

	M	Baro										Hygrometer.					
	Collat olog vani	9, P. M.		S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1	Phi	29.95	3	5	$\frac{2}{3}$	$2\frac{1}{3}$	$\frac{1}{8}$	$1\frac{1}{3}$	.	.	4	....	.	......	....	..	1528
2	Mo																
3	Buc	29.94	3	$5\frac{2}{3}$	1	3	.	$7\frac{1}{3}$	$\frac{2}{3}$	.	$\frac{1}{3}$	....	.	......	....	..	1523
4	Leh																
5	Nor																
6	Mo																
7	Pik																
8	Wa																
9	Sus	28.03	2	5	.	5	.	$6\frac{2}{3}$	$\frac{2}{3}$	.	.	....	.	......	....	..	1546
10	Luz																
11	Sch	29.28	2	$2\frac{2}{3}$	.	$8\frac{1}{3}$	.	$\frac{1}{3}$	.	$8\frac{2}{3}$	2	....	.	......	....	..	1517
12	Ber																
13	Che																
14	Del	29.35	2	5	$1\frac{2}{3}$	$2\frac{1}{3}$	2	1	$\frac{2}{3}$	$1\frac{1}{3}$	$3\frac{1}{3}$	61.60	10	......	71.65	10	1530
15	Lan	29.44	2	$1\frac{2}{3}$	$3\frac{2}{3}$	4	$1\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{2}{3}$	.	.	62.94	.	......	68.90	.	1520
16	Yor																
17	Leb																
18	Dau	29.65	2	$6\frac{2}{3}$	.	7	.	$4\frac{1}{3}$	.	.	$1\frac{1}{3}$	....	.	......	....	..	1509
19	Nor	29.40	2	1	.	$4\frac{1}{3}$	$\frac{1}{3}$	$1\frac{1}{3}$	.	$5\frac{1}{3}$	.	....	.	......	70.42	..	1510
20	Col																
21	Bra																
22	Tio																
23	Lyc																
24	Uni																
25	Miff																
26	Jun	29.39	29	$3\frac{2}{3}$	.	$1\frac{2}{3}$	.	$1\frac{1}{3}$	.	$17\frac{1}{3}$	$1\frac{1}{3}$	....	.	.....	....	..	1516
27	Per																
28	Cun	29.34	29	3	$\frac{2}{3}$	$4\frac{1}{3}$	1	2	.	$7\frac{1}{3}$	$\frac{1}{3}$	62.05	1	......	67.86	1	1511
29	Ada	29.33	29	$3\frac{2}{3}$	1	$1\frac{2}{3}$	$\frac{2}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	5	.	64.11	.	......	69.61	..	1527
30	Fra																
31	Hun	29.32	29	.	.	21	.	.	.	.	$1\frac{1}{3}$	....	.	.....	....	..	1533
32	Cen	29.22	29	$1\frac{2}{3}$	$\frac{2}{3}$	$2\frac{2}{3}$	$\frac{1}{3}$	.	.	1	17	....	.	......	....	..	1518
33	Pott																
34	M'K	......	..	$5\frac{1}{3}$	.	$10\frac{1}{3}$	.	5	.	.	.	....	.	.....	....	..	1529
35	Clea																
36	Can	27.97	28	$7\frac{2}{3}$	.	6	$\frac{1}{3}$	5	.	$4\frac{1}{3}$	$2\frac{2}{3}$	....	.	.....	....	..	1515
37	Bed	29.19	29	$4\frac{1}{3}$	1	$2\frac{1}{3}$	11	2	.	.	$\frac{2}{3}$	....	.	.. .	....	..	1512
38	Som	27.84	28	$2\frac{2}{3}$	$1\frac{2}{3}$	$5\frac{1}{3}$	.	$\frac{1}{3}$	.	$11\frac{2}{3}$	$3\frac{2}{3}$	....	.	.....	76.26	7	1532
39	Indi	28.61	28	$1\frac{2}{3}$	.	9	.	$1\frac{2}{3}$	.	$16\frac{2}{3}$	$\frac{1}{3}$	....	.	......	....	..	1635
40	Jeffe																
41	Wa																
42	Ven	29.02	29	4	.	.	.	$13\frac{1}{3}$	.	.	10	....	.	.....	....	..	1531
43	Arm																
44	Wes																
45	Faye	28.97	29	10	.	$6\frac{1}{3}$	.	8	.	$4\frac{2}{3}$	.	....	.	......	....	..	1605
46	Gree																
47	Was																
48	Alle	29.19	29	$1\frac{2}{3}$	.	2	$\frac{2}{3}$	6	$\frac{1}{3}$	13	1	....	.	......	....	..	1513
49	Bea	29.36	29	3	.	.	$\frac{1}{3}$	$10\frac{1}{3}$	$\frac{1}{3}$	7	$1\frac{2}{3}$	....	.	......	....	..	1588
50	Butl	28.80	29	$9\frac{1}{3}$	.	10	.	1	.	.	.	....	.	......	....	..	1524
51	Mer																
52	Cra	28.72	28	$\frac{2}{3}$	.	$1\frac{2}{3}$	.	$2\frac{1}{3}$	$\frac{1}{3}$	14	$2\frac{2}{3}$	....	.	......	....	..	1514
53	Erie,																

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

JUNE, 1841.

County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum	Mean.	Days omitted.	Weather. Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.
1 Philadelphia,	Philadelphia,	G. P. Schively,	70.18	80.50	73.82	94.00	56.50	74.83	3	50.00	64.53	1	29.99	29.97	29.95	30.21	29.71	29.97	3	14	13	3	10	.....	.....	1	3.876
2 Montgomery,																											
3 Bucks,	Newtown,	L. H. Parsons,	65.86	73.60	63.86	90.50	52.50	67.77	.	47.00	59.90	.	29.96	29.94	29.94	30.18	29.71	29.95	.	15⅔	13⅓	1	13	.....	.....	..	5.104
4 Lehigh,																											
5 Northampton,	Easton,	Charles Elliot,																									
6 Monroe	Stroudsburg,	A. M. Stokes,																									
7 Pike,	Milford,	Ralph Bull,																									
8 Wayne,	Honesdale,	W. Richardson,																									
9 Susquehanna,	Silver Lake,	E. Rose,	59.50	74.17	64.53	92.00	40.00	66.06	.	40.00	55.83	.	28.06	28.07	28.03	28.30	27.65	28.05	.	16⅔	13⅓	.	9	.....	.....	..	2.740
10 Luzerne,	Wilkesbarre,	V. L. Maxwell,																									
11 Schuylkill,	Port Carbon	P. C. Lyceum,	64.37	83.91	65.12	98.00	53.00	71.13	2	37.00	53.07	.	29.28	29.30	29.28	29.45	29.09	29.28	2	13⅓	14	2⅔	9	.....	.....	..	4.685
12 Berks,	Reading,	C. F. Egelmann,																									
13 Chester,	West Chester,	Wm. W. Jeffris,																									
14 Delaware,	Haverford,	Haverford School,	71.41	71.41	72.33	82.00	64.00	72.71	7⅓	49.00	63.74	2	29.35	29.34	29.35	29.55	29.13	29.34	7⅓	11	11⅔	7⅓	8	.....	.....	2	5.573
15 Lancaster,	Lancaster,	Conservatory of Arts,	69.27	83.00	73.37	93.00	60.00	75.21	.	54.00	64.62	.	29.46	29.45	29.44	29.65	29.21	29.45	.	16⅔	13⅓	.	6	.....	.....	2	3.755
16 York,																											
17 Lebanon,																											
18 Dauphin,	Harrisburg,	J. Heisely,	73.90	79.46	79.34	88.00	67.00	77.57	1⅓	55.00	66.38	1	29.69	29.68	29.65	29.84	29.45	29.67	1⅓	.	.	.	9	.....	.....	2	3.205
19 Northumberland,	Northumberland,	Andrew C. Huston,	68.23	76.80	71.87	88.00	58.00	72.30	.	45.00	60.07	.	29.43	29.40	29.40	29.58	29.18	29.41	.	10⅔	19⅓	.	8	.....	.....	2	2.692
20 Columbia,	Danville,	C. H. Frick.																									
21 Bradford,																											
22 Tioga,																											
23 Lycoming,																											
24 Union,																											
25 Mifflin,																											
26 Juniata,	Mifflintown,	J. A. Kinkead,	75.69	80.69	78.11	90.00	70.00	78.16	2⅓	......	......	.	29.42	29.38	29.39	29.57	29.17	29.40	1⅔	14⅓	13⅔	2	6	.....	.....	1	2.200
27 Perry,																											
28 Cumberland,	Carlisle,	Prof. W. H. Allen,	73.47	79.43	76.00	88.00	68.00	76.30	⅓	53.00	63.37	.	29.36	29.34	29.34	29.50	29.13	29.34	⅓	16	13⅔	⅓	8	.....	.....	..	4.065
29 Adams,	Gettysburg,	Prof. M. Jacobs,	72.32	73.34	73.17	85.50	64.00	72.94	.	53.00	60.66	.	29.31	29.33	29.33	29.49	29.15	29.32	.	17⅓	12⅔	.	8	.....	.....	..	2.887
30 Franklin,																											
31 Huntingdon,	Huntingdon,	Prof. Jacob Miller,	74.76	77.85	77.97	84.00	68.00	76.82	1⅔	......	......	.	29.34	29.32	29.32	29.47	29.14	29.32	1⅔	18	12	.	9	.....	.....	..	3.486
32 Centre,	Bellefonte,	John Harris,	70.67	84.24	76.23	94.00	62.00	77.05	9	......	......	.	29.25	29.24	29.22	29.38	29.05	29.24	9	12⅓	8⅔	9	2	.....	.....	2	3.788
33 Potter,																											
34 M'Kean,	Smithport,	M. R. Atkins,	62.67	76.70	64.69	87.00	50.00	68.02	⅓	40.00	54.50	.	......	......	......	......	......	......	.	17⅔	12⅓	.	.....	.....	.....	..	.....
35 Clearfield,																											
36 Cambria,	Ebensburgh,	Richard Lewis,	65.71	76.42	70.52	87.00	51.00	70.88	3	40.00	57.61	2	28.02	27.94	27.97	28.10	27.74	27.98	3	10	17	3	4	.....	.....	5	3.570
37 Bedford,	Bedford,	Samuel Brown,	74.86	78.21	76.67	84.00	64.00	76.58	⅔	......	......	.	29.19	29.19	29.19	29.33	29.01	29.19	⅔	17⅓	12	⅔	.....	.....	.....	..	......
38 Somerset,	Somerset,	George Mowry,	67.00	75.12	70.54	84.00	56.50	70.89	3⅔	45.00	60.02	2	27.85	27.86	27.84	28.00	27.68	27.85	3⅔	10⅔	15⅓	3⅔	8	.....	.....	4	5.502
39 Indiana,	Indiana,	Richard White,	71.67	74.10	72.33	80.00	65.00	72.70	.	......	......	.	28.61	28.61	28.61	28.70	28.50	28.61	.	21⅓	8⅔	.	11	.....	.....	..	2.200
40 Jefferson,	Rose Cottage,	C. C. Gaskell,																									
41 Warren,	Warren,	J. E. King,																									
42 Venango,	Franklin,	Wm. Connely,	61.50	83.59	64.64	98.00	41.00	69.91	8	......	......	.	29.06	29.08	29.02	29.70	28.70	29.05	8½	.	.	.	7	.....	.....	..	1.927
43 Armstrong,																											
44 Westmoreland,																											
45 Fayette,	Uniontown,	J. P. Weethee,	71.04	80.47	76.17	89.00	61.00	75.89	.	......	......	.	29.01	29.01	28.97	29.12	28.70	29.00	.	25⅓	4⅔	.	5	.....	.....	4	4.700
46 Green,																											
47 Washington,	Cannonsburg,	Prof. A. H. Campbell,																									
48 Alleghany,	Pittsburgh,	J. P. Bakewell,	67.87	80.43	71.90	92.00	57.00	73.40	⅔	50.00	63.87	.	29.22	29.18	29.19	29.38	29.01	29.20	⅓	13⅓	16⅓	⅓	8	.....	.....	3	5.464
49 Beaver,	Beaver,	James Allison,	72.07	76.00	75.28	89.00	65.00	74.45	1	52.00	60.50	2	29.39	29.35	29.36	29.55	29.20	29.37	1⅓	15	13⅔	1⅓	6	.....	.....	2	6.413
50 Butler,	Butler,	Jacob Mechling,	68.47	81.67	74.63	94.09	52.00	74.92	.	......	......	.	28.78	28.78	28.80	29.00	28.60	28.78	.	.	.	.	5	.....	.....	3	3.366
51 Mercer,	West Greenfield,	S. Campbell,																									
52 Crawford,	Meadville,	Henry Shippen,	64.85	81.50	65.58	91.00	50.00	70.64	.	43.00	57.72	.	28.73	28.72	28.72	28.86	28.53	28.72	⅓	11⅔	16⅓	2	.....	.....	.....	..	......
53 Erie,	Erie,	Park & Reid,																									

County.	Winds. North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Hygrometer. Dew-point.	Days omitted.	Diff. therm. and dew-point.	Wet Bulb.	Days omitted.	No. of Report.
1 Philadelphia,	3⅓	.	2⅔	⅔	1⅔	⅓	3⅓	.	4	⅓	5	⅔	2⅓	⅙	1⅓	.	.	4	....	.	......	....	..	1528
3 Bucks,	⅓	.	4⅔	.	⅓	.	4	⅔	2	.	5⅔	1	3	.	7⅓	⅔	.	⅓	....	.	......	....	..	1523
9 Susquehanna,	4⅓	.	2⅓	.	.	.	.	.	6	.	5	.	5	.	6⅔	⅔	.	.	....	.	......	....	..	1546
11 Schuylkill,	⅔	.	3	.	2	.	1	.	1⅓	.	2⅔	.	8⅓	.	⅓	.	8⅔	2	....	.	......	....	..	1517
14 Delaware,	2	1	⅔	1⅓	2	⅔	1	⅓	2⅓	1⅓	5	1⅔	2⅓	2	1	⅔	1⅓	3⅓	61.60	10	......	71.65	10	1530
15 Lancaster,	2⅔	⅓	2⅔	.	⅓	1	2⅔	1	4⅔	1	1⅔	3⅔	4	1⅓	1⅓	1⅔	.	.	62.94	.	......	68.90	.	1520
18 Dauphin,	.	.	.	.	6	.	4	.	⅔	.	6⅔	.	7	.	4⅓	.	.	1⅓	....	.	......	....	..	1509
19 Northumberland,	2⅓	⅓	2	.	2	.	4⅓	⅓	6⅓	.	1	.	4⅔	⅓	1⅓	.	5⅓	.	....	.	......	70.42	..	1510
26 Juniata,	⅔	.	⅓	.	⅔	.	3	.	.	.	3⅔	.	1⅔	.	1⅓	.	17⅓	1⅓	....	.	......	....	..	1516
28 Cumberland,	⅔	.	2⅔	.	2	.	2	.	3⅔	⅓	3	⅔	4⅙	1	2	.	7⅓	⅓	62.05	1	......	67.86	1	1511
29 Adams,	4⅓	⅓	1⅔	⅓	⅓	.	⅓	1	8	1	3⅔	1	1⅔	⅔	⅓	⅓	5	.	64.11	.	......	69.61	..	1527
31 Huntingdon,	.	.	.	.	8⅔	.	.	.	.	.	.	.	21	.	.	.	.	1⅓	....	.	......	....	..	1533
32 Centre,	1⅔	.	1	.	⅓	⅓	⅓	.	3	.	1⅔	⅔	2⅔	⅓	.	.	1	17	....	.	......	....	..	1518
34 M'Kean,	.	.	1	.	5⅓	.	2	.	1	.	5⅓	.	10⅓	.	5	.	.	.	....	.	......	....	..	1529
36 Cambria,	1	.	.	.	.	.	1⅓	⅔	1	.	7⅔	.	6	⅓	5	.	4⅓	2⅔	....	.	......	....	..	1515
37 Bedford,	⅓	.	.	.	.	3⅓	4⅔	.	⅓	.	4⅓	1	2⅓	11	2	.	.	⅔	....	.	.. .	....	..	1512
38 Somerset,	⅔	.	.	.	.	.	⅔	.	3⅓	.	2⅔	1⅔	5⅓	.	⅓	.	11⅔	3⅔	....	.	......	76.26	7	1532
39 Indiana,	.	.	.	.	⅓	.	⅓	.	.	.	1⅔	.	9	.	1⅔	.	16⅔	⅓	....	.	......	....	..	1635
42 Venango,	.	.	.	.	.	.	2⅔	.	.	.	4	.	.	.	13⅓	.	.	10	....	.	......	....	..	1531
45 Fayette,	.	.	⅓	.	.	.	⅓	.	⅓	.	10	.	6⅓	.	8	.	4⅔	.	....	.	......	....	..	1605
48 Alleghany,	⅓	.	⅓	⅔	⅓	.	3⅔	.	.	.	1⅔	.	2	⅔	6	⅓	13	1	....	.	......	....	..	1513
49 Beaver,	⅔	.	⅔	.	⅓	½	5	⅓	.	.	3	.	.	⅓	10⅓	⅓	7	1⅔	....	.	......	....	..	1588
50 Butler,	⅓	.	1	.	8⅓	.	.	.	.	.	9⅓	.	10	.	1	.	.	.	....	.	......	....	..	1524
52 Crawford,	2⅔	⅓	⅔	.	⅔	.	1⅔	⅓	2	.	⅔	.	1⅔	.	2⅓	⅓	14	2⅔	....	.	......	....	..	1514